ON THE COVER

DESPITE the eerie atmosphere, which is conducive to imagining all sorts of things, our cover picture portrays a prosaic scene. It does not, as one viewer thought, depict a diver in deadly combat with an octopus. Actually, the man is gripping a hose that delivers sand under high air pressure for cleaning a heat-treated section of an engine manifold. The heavy suit protects him from flying particles, and the hose running up his back delivers a supply of clean air for breathing.

●

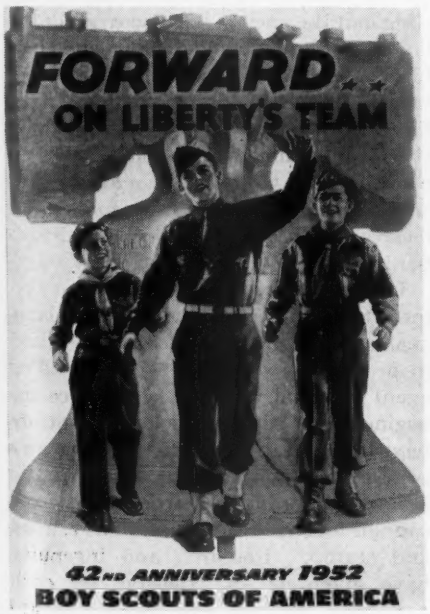
CORRECTIONS

IN THE article *Gypsies of the Rails* (November issue), Author Roy E. McFee located the 29-mile-long Lancaster & Chester Railway in Pennsylvania. Robert O. Mayer, a railroad fan of Cincinnati, informs us that it is in South Carolina and adds: "Col. Elliott Springs of Springs Cotton Mills would be greatly perturbed if he found someone had moved *his* railroad that far. And the 32 'Veeps' might not know where to report for work."

The Official Guide of Railways, which confirms Mr. Mayer's location of the carrier, gives further enlightenment on this remarkable road. To staff it, Colonel Springs has handed out titles with a lavish hand. We find, for instance, that its five surgeons live in four states; that Robert T. (Bobby) Jones of golf fame is one of its two attorneys; that Lowell Thomas is its advertising agent; and that men prominent in many walks of life are among its 32 vice-presidents. Known as the "Springmaid Line," the carrier boasts that it was the "first 100 percent diesel-operated road in South Carolina."

●

IN EDITING an item on this page last month it was made to state that Chief Joseph Dam is the largest man-made structure. That distinction belongs, of course, to Grand Coulee Dam just upstream from Chief Joseph on the Columbia River.



BOY scout week will be observed from February 6 to 12, during which period President Truman will greet twelve outstanding scouts to be selected for the honor. Since 1910 more than 19,000,000 boys and men have participated in scouting and 2,900,000 are now engaged in it.

Compressed Air Magazine

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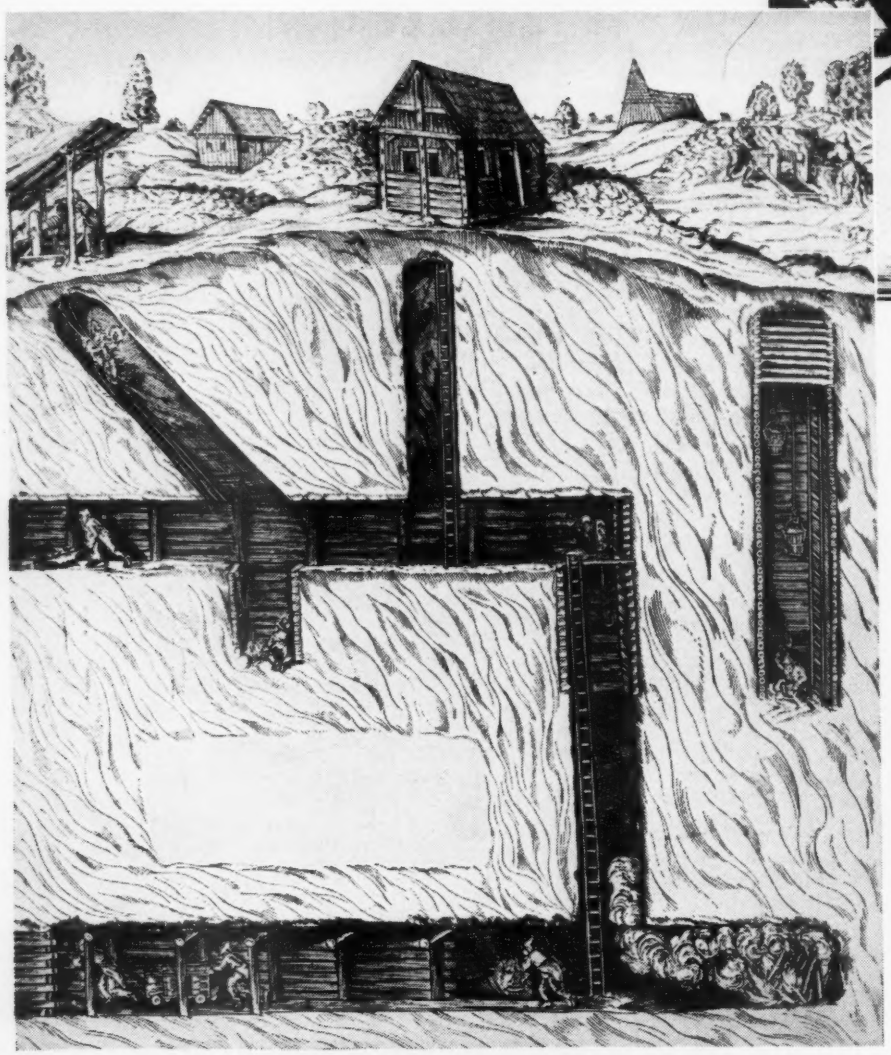
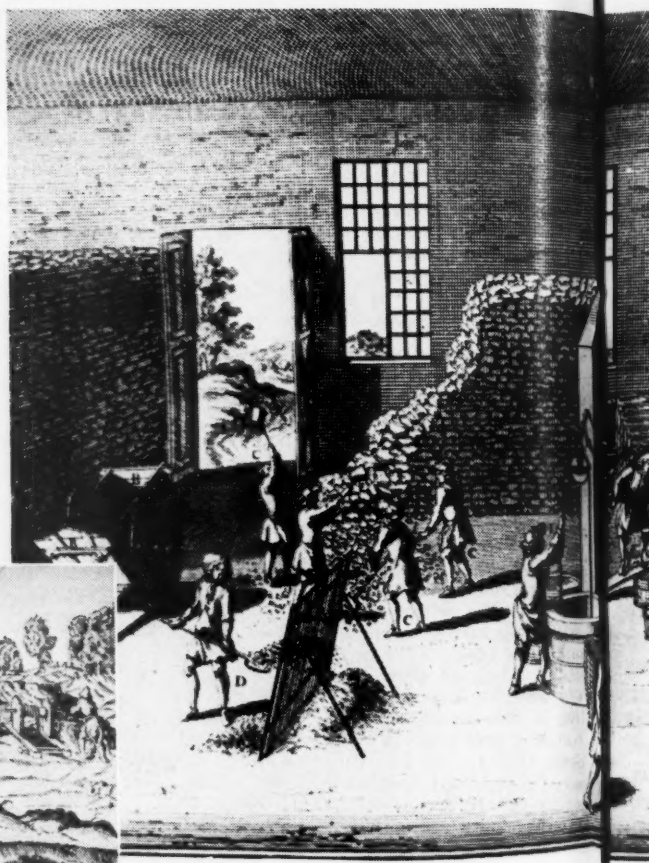
History of Explosives

Breaking of Rock and Mineral Essential to Our Modern Economy Depends on These Reagents

J. C. Pierce





BETTMANN ARCHIVE PRINTS

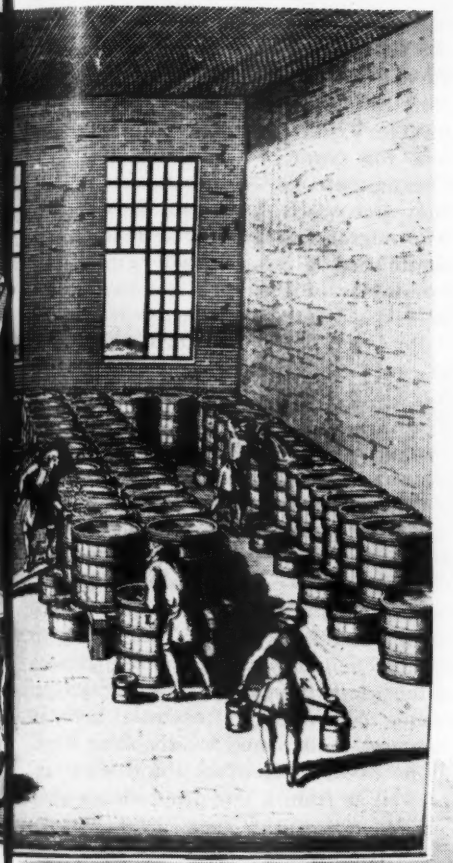
SEVENTEENTH-CENTURY MINING

An illustration from the "Book of Mining" written by Lohnez in 1617. Endeavoring to show several typical operations at once, the author violated a safety regulation respected even in those days when he depicted the breaking of rock by firesetting (lower-right) while men were in connected workings. Agricola in "De Re Metallica" (1558) stated: "While the heated veins and rock are giving forth a foetid vapour and the shaft and tunnels are emitting fumes, the miners and other workmen do not go down in the mines lest the stench affect their health or actually kill them." By that procedure, used for breaking rock long before the discovery of black powder, the fire loosened the rock or mineral by causing it to decrepitate and crack or by further expanding small fractures; or the heat merely softened the material so that it could be easily gouged out. In surface or shallow-excavation firesetting, water or vinegar was often dashed on the heated rocks to increase fracturing by sudden temperature changes.

THE history of the explosives industry is an inspiring chapter in the story of man's continual effort to seek out, harness and control sources of energy. His early acquaintance with the potential energy in the bent bow, the sling and the spring; his discovery of the latent energy in wood, asphalt and coal; his knowledge of the kinetic energy of wind and water; his awakening to the fact that energy can be multiplied by the lever, pulley, screw and gear — all were stepping stones in his mastery over energy and means of releasing it effectively and safely at will to his advantage.

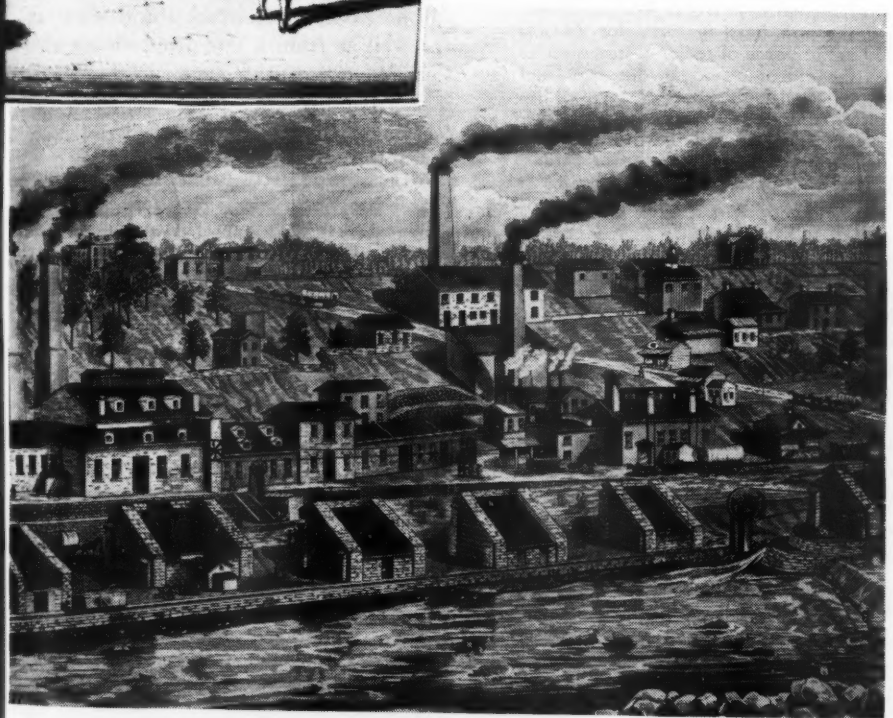
Ironically, though typical of man's efforts to attain a higher cultural plane, explosives found their first application in destructive devices—as a propelling agent in lethal weapons. But since the beginning of time, articles of warfare have been put to peacetime use for man's comfort and convenience. It naturally followed that black powder went from cannon and rifle to mine, quarry, road and stump. Research and ingenuity have given us an explosive for each particular weapon and industrial application—one that can be controlled in service and handled with safety.

The explosives industry today is truly a key industry, for its products make available the necessary raw materials upon which many other essential industries are based. The great mines, the extensive transportation arteries, many inland waterways, vast areas of cleared



EARLY SALTPETER WORKS

This 1697 scene (left) in the saltpeter (potassium nitrate) works of the City of Paris shows the tedious way in which that gunpowder ingredient was obtained. The stacks of raw material at the left were undoubtedly masonry recovered from cellars or stables and possibly rock from caves. Where soils and rocks containing potassium nitrate come in contact with decaying nitrogenous matter, alkalies, air and moisture, the saltpeter effloresces, indicating its presence. Early European manufacturers depended largely for their saltpeter upon that source and upon the "barnyard" method explained in the text. Workmen are seen breaking down rock with large sledges, which liberated a great deal of the saltpeter from the other components. Worker "D" is screening the crushed material, which appreciably concentrated the soft and friable saltpeter. The screenings were progressively leached with water in the barrels at the right. After the liquid had repeatedly percolated through the material in the larger barrels and passed into the small ones beneath, the solution was allowed to evaporate, leaving crystalline potassium nitrate ready for mixing with charcoal and sulphur to make gunpowder.



EARLY DU PONT POWDER PLANT

Eleuthere Irenee du Pont, with his father and elder brother, landed at Newport, R.I., from France on New Year's Day, 1800. He had studied powder chemistry under the French chemist Lavoisier and quickly recognized the opportunity that lay in introducing in America methods of black-powder manufacture as used in the French Government works. In 1802 he began building the first du Pont powder mills on Brandywine Creek near Wilmington, Del. Towards the middle of the century the plant had grown into the sizable group of structures shown.

agricultural land, gigantic dams furnishing irrigating water and hydroelectric power — all are fundamental to world progress and would not have reached their high stage of development without explosives. Well-nigh all articles of daily use—the telephone, radio, automobile, refrigerator—are blessings dependent to a great extent upon dynamite.

Commercial explosives were ushered into the world as black powder or "gunpowder," as it was commonly called because of its early application. Most recent historians discredit the belief that the explosive mixture of saltpeter (potassium nitrate), sulphur and carbon was discovered and used as a propellent in crude cannon in the eighth century. "Greek Fire," that incendiary blend of resin, pitch, sulphur, naphtha and possibly other combustibles, dates back to at least 350 A.D. and has often been referred to as gunpowder, probably because it served as a weapon. Actually, we are told, it was manually or mechanically thrown as a fiery mass against buildings, onto ships and into groups of enemy warriors. A tenth-century Chinese version of the "Roman Candle" did have saltpeter in its flaming compound, but there is no record of its use by those people as a propellent or explosive until well after the documented invention of gunpowder.

Claiming credit for the discovery of black powder are the Chinese, Hindus, Greeks, Arabs, English and Germans. But it is generally accepted that England's Friar Roger Bacon (1214-1294) was responsible for it, whereas Berthold Schwarz of Germany, the inventor of firearms in the late thirteenth or early fourteenth century, was the first to put it to practical use. Bacon apparently had no knowledge of its power, nor did he foresee its peaceful applications. He happened on the mixture, found that it made a "thundering noise and bright flash," and then devoted much of his time to perfecting the formula, partly in defense of the accusations of witchcraft made against him for concocting such a supernatural substance. The earliest authentic military use of Schwarz's guns was in England in 1314, and from that date on literature is rich in material on the development and application of firearms.

Coming at a time when military might was uppermost in the minds of ambitious rulers, gunpowder was slow in finding uses of service to mankind. Even after Kaspar Weindl introduced a crude blasting technique in the mines of Schemnitz, Hungary, in 1627, it took a long time to overcome the fears and forebodings of the workers. Gradually, however, black powder partly replaced the crude hand and fire methods practiced in Germany and Sweden and finally, about 1670, in England. It was not until the widening of the Albula Road in Switzerland in 1696 that construction enterprises began to use black powder for blasting rock. However, the high cost of powder and the absence of effective boring machines retarded that industrial application.

The first powdermakers groped in the dark in trying to produce an effective mix from their ingredients. Their raw materials were variable in purity, their methods of testing were inadequate, their manufacturing equipment makeshift. But strangely enough, the formula they prescribed was essentially the same as it is today. Black powder was and is an intimate mixture of finely ground

EARLY RAILROAD TUNNEL

A sketch made in the Hoosac Tunnel on November 27, 1873, the day before holing through. This bore, on the Troy & Greenfield Railroad near North Adams, Mass., was noteworthy on several counts. Carried through hard material for 24,000 feet, it required the breaking of some 361,000 cubic yards of rock—a tremendous undertaking for its time. It was started with the aid of black powder and then served as a proving ground for nitroglycerine, electric blasting caps, and the electric blasting machine. To furnish the nitroglycerine, George Mordey Mowbray set up a manufacturing plant at the tunnel portal, and there discoverer Sobrero's laboratory method was used on a commercial scale for the first time. The ingredients were agitated with compressed, cold dry air.

solids: approximately 75 percent potassium nitrate, 15 percent carbon and 10 percent sulphur. In those days, the saltpeter was either a natural mineral found at a few European points and in large quantities in India or a product of decomposed vegetable and other organic matter. The carbon was wood charcoal, and a plentiful supply of sulphur was obtained in the natural state from volcanic sources and from evaporated waters high in sulphur content. At an early stage the demand for fine-grained powder for small arms and coarser charges for cannon led powder-makers to develop wet mixing, pressing and other basic refinements of manufacture that have persisted through the years.

As a protection against the dangers in the New World and to provide food, firearms and kegs of powder were among the cargoes unloaded from the boats that brought the Cavaliers to Jamestown in 1607 and the Pilgrims to Plymouth in 1620. Without known deposits of saltpeter, and because of the uncertainty of shipments from England, the settlers gave immediate thought to making saltpeter by the only means they knew. Individually, they collected vegetable and animal refuse high in nitrogen, heaped it under roofs, mixed ashes and limestone or slack lime with it, wetted it occasionally with runnings from stables and waited for the mass to decompose. Then the piles were leached with water and the resulting liquor was collected and allowed to evaporate, leaving saltpeter crystals. These individual enterprises gradually gave way to community projects and to commercial saltpeter plants.

About 1670, powder mills were erected at Milton and Dorchester, Mass. But even then, the trickle of saltpeter from abroad placed the Colonies in a grave position in the face of the increasing Indian depredations. And 100 years later the American Revolution found the settlers still inadequately supplied with gunpowder. General George Washington, after personally investigating the matter in August, 1775, wrote Congress: "Our situation in the article of powder is much more alarming than I had the most distant idea of."

Beginning with 1800, the American powder industry shed its homespun and put on garb befitting a business of established national importance. This change coincided with a period of great progress in black-powder research and production in the Old World. Theorists, ballistics experts, scientists and industrialists everywhere were bent on improving the technique and on extending manufacturing facilities. The new United States didn't lag behind in its determination to make itself independent of powder from abroad (some claim the Colonists could not have won the Revolution without powder imported from France) and to satisfy the growing need for explosives in mines and quarries and for various engineering projects. Coming onto the American scene about that time was E. I. du Pont de Nemours who migrated from France in 1800 and established a black-powder mill—the forerunner of the great company that bears his name today.

Between 1810 and 1820 work was started on the first national highway joining the Potomac and Ohio rivers. The Erie Canal was dug between 1820 and 1830, and the Baltimore & Ohio Railroad was put in operation in that period. In the next decade the Croton Aqueduct was constructed to supply New York City with water. The mills that made the powder for these undertakings and for military purposes were mostly small, production ranging up to 250,000 pounds yearly. The 1810 census listed more than 200 plants in sixteen states. The supply of essential nitrates for these mills came mostly from limestone caves in Kentucky and Virginia, as well as from a few other states that yielded nitrate-rich rock, earth and organic material, and was augmented by a flow of saltpeter from the East Indies.

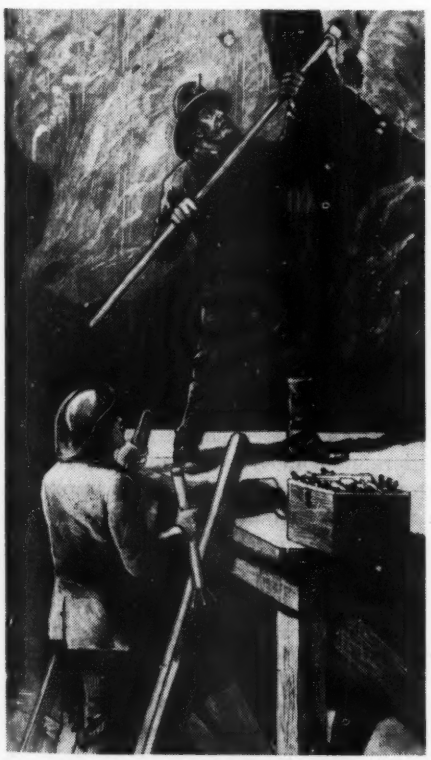
As the use of powder increased, fatalities rose, and a fretful public demanded safer methods of firing charges. They were commonly ignited by a train of fine powder, sometimes crudely enclosed in goose quills, straws, rushes, or paper or wooden tubes. But the interval between ignition and the blast was always a matter of speculation, and accidents from premature shots were common.

Credit for the first safe method of ignition goes to William Bickford of Tuckingmill, Cornwall, England, who, in 1831, devised a jute-thread tube protecting a thin and continuous core of powder along which the fire could travel slowly at a uniform and determined rate of speed. Patented as "Miner's Safety Fuse," it reduced the number killed and injured from blasting accidents in West Cornwall by more than 90 percent. American mining man Richard Bacon brought the Bickford fuse to America in 1836, and from that beginning Ensign-Bickford Company of Simsbury, Conn., has become a leader in fuse and detonator making.

But the black powder we have been discussing was not the explosive a progressive world needed because its application is limited. The water-soluble nitrate and the fact that the explosive is of the deflagrating type that must be set in action by ignition precludes its use in wet areas. It imparts a low-velocity force suitable for only a few purposes. It is bulky and therefore does not meet the many conditions encountered in the ever-broadening field of service. Chile

saltpeter or sodium nitrate, found in abundance in Chile and substituted successfully in 1857 by Lammot du Pont for the less plentiful and more expensive potassium nitrate, did not alter the physical or chemical properties of black powder. It remained for dynamite to fill the gap left by Bacon's compound.

Unwittingly, two men started a chain reaction in explosives chemistry in the middle of the nineteenth century with key discoveries that opened the door to dynamite and high explosives. C. F. Schoenbein, a German physicist, nitrated cellulose to produce guncotton at Basel, Switzerland, in 1845. During the following year, Ascanio Sobrero, professor of industrial chemistry at the University of Turin, compounded nitroglycerine, which he called "pyroglycerine" when he announced it to the Royal Academy of Science in 1847. With that start, Swedish Emmanuel Nobel and his four sons pioneered in the use of that explosive, one of its earliest applications being in connection with Russian torpedoes for the Crimean War in 1853. To the third son, Alfred Bernhard, goes the credit for the invention of dynamite—the tamer of nitroglycerine.



BETTMANN ARCHIVE PRINT

HELL GATE OPENED

This picture shows how dynamite, a then new explosive, was loaded into holes drilled in the galleries of Flood Rock in Hell Gate, Long Island Sound entrance to New York Harbor. Prior to the firing of the final grand blast on October 10, 1885, obstructing rocks rendered the inside passage useless for most vessels. As early as 1832 Congress had appropriated money to remove them, but the task was considered impracticable. The advent of dynamite and dependable mechanical rock drills made it possible to do the job.

Alfred Bernhard Nobel ran the family's nitroglycerine manufacturing business from about 1864, shipping packets the globe over under the trade name of Glonion Oil. In America it was dubbed "patent blasting oil," and was first used in New York City on July 15, 1865. Premature explosions, some costing much loss of life and property, drove Nobel deeper into the search for a means of preparing nitroglycerine so that it could be transported and handled safely. Mixing it with other liquids and a variety of solids, including sawdust, did not give him the answer he was striving to find, but Lady Luck came to his aid in 1867.

Near Krummel in Hanover, the site of Nobel's factory, was a large deposit of kieselguhr, a porous earth which had been used to make the floor on which a leaky can of nitroglycerine was stored. The material had absorbed about three times its weight in nitroglycerine and was found to be pastelike so that it could be easily kneaded. Packed in cartridges, this mixture proved to be reasonably resistant to shock and could be shipped and handled with comparative safety. Nobel named his new mixture dynamite. At last nitroglycerine was subdued.

Another of Nobel's great accomplishments antedates his discovery of dynamite by three years. Nitroglycerine had an energy potential that was being wasted because of unsatisfactory means of initiating the release of that energy. Several methods had been tried, including setting off a small black-powder charge in contact with the nitro, but all either appreciably reduced the efficiency of the blast or were a complete failure. Nobel then conceived the idea of utilizing gun caps charged with mercury fulminate, a violently explosive compound. The results were heartening, and the blasting cap was born for detonating nitroglycerine and, later, dynamite and the other high explosives that followed.

Today, it is common practice to fire explosives electrically. However, Nobel's first blasting caps were designed to be detonated by a Bickford-type fuse, and this method is still applied where electric energy is not readily available or where blasting is done under conditions not conducive to its use. It is surprising to learn that an electric detonating machine appeared in America before the Revolution. Versatile Benjamin Franklin built a crude device that generated static electricity by friction between glass and silk, and in his *Letters on Electricity*, dated June 29, 1751, he fully described its use in firing gunpowder with an improvised black-powder cartridge.

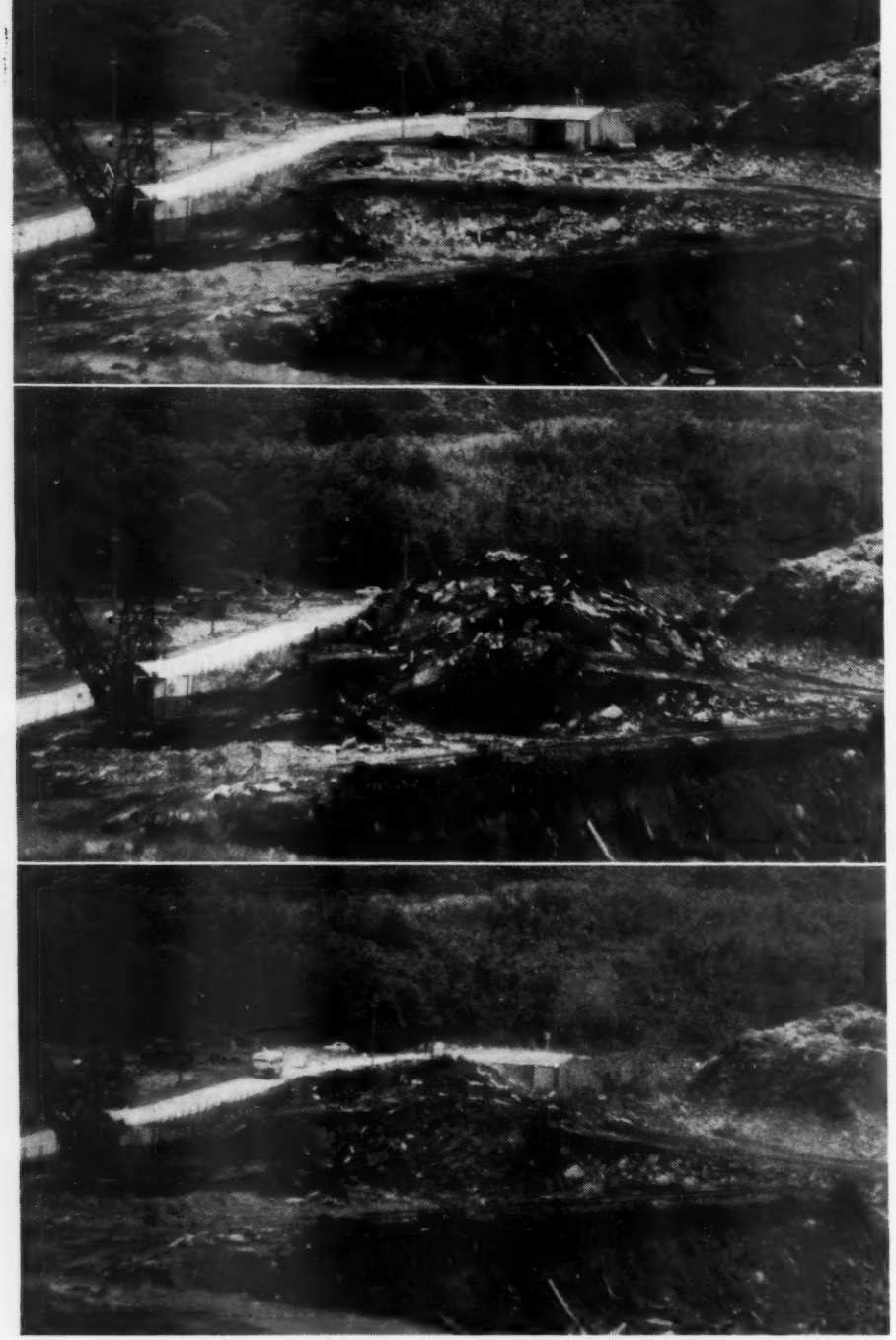
Nobel's dynamite was variously heralded as "the mighty workman of all

DITCHING A RIVER BOTTOM

A blast in the Potomac River raised a geyser of water as Anderson Brothers Corporation excavated a ditch well below the river bottom in which to lay a section of the Transcontinental Gas & Transmission Company's pipe line. The success of such blasting operations depends upon placing drill holes properly and using the correct kind and amount of explosive.

mankind — the super-force — the greatest boon that has ever been created for overcoming the obstacles in Nature." Under the original Nobel patents, the Giant Powder Company of California, which became a part of the Atlas Powder Company about 40 years ago, made the first dynamite in this country in 1868. A great variety of explosive mixtures and absorbent mediums (called "dope" in the explosives trade) were developed and patented. Industrialists soon erected plants in New Jersey and Massachusetts, as well as in Bohemia, Finland, Scotland, France, Germany, Spain, Switzerland, Italy, Portugal and Hungary.

Although a man of varied interests and with plants scattered throughout the world, Nobel was not finished with research in the explosives field. He continued to look for a better dope for nitroglycerine, preferably one that would not only serve as an absorbent and filler material but that would also contribute to its explosive energy. During this search he treated an injured finger with collodion, and that suggested a third Nobel triumph. He mixed a small amount of the solution with nitroglycerine and found that he had a gelatinous substance with some desirable physical qualities. In 1865, Sir Freder-



CONTROLLED BLASTING

When Fauzio Brothers set off some 10,000 pounds of explosives in a coal-stripping blast, their powdermen knew that the shed, shovel, and road would not be damaged. Five intervals of Atlas Powder Company's Rockmaster millisecond-delay electric blasting caps prevented serious concussion and "throw" from this tremendous release of energy. Traffic was moving on the road in less than a minute. In a few seconds, thousands of tons of overburden had been loosened from the Lehigh Navigation Coal Company coal seam near Nesquehoning, Pa.

ick Abel, an English chemist, had developed a process for washing nitrocellulose (Schoenbein's guncotton) which rendered it safe to store and use. Nobel combined this with his collodion-nitroglycerine and thus formed the plastic material he called blasting gelatin—the most powerful commercial explosive known today. He subsequently mixed this with other materials, making a series of gelatins which, in 1875, he patented along with the blasting gelatin as gelatin dynamites.

From that time on, the manufacture and use of explosives moved so rapidly that only a sketchy account of the details is possible here. Potassium-chlorate dynamite came into fairly widespread use around 1875. Ammonium-nitrate formulae appeared in Europe a few years later and were introduced in America for general blasting purposes about 1892. Permissible explosives, developed in Europe about 1885, came to America in 1908. (The term "permissible" signifies that the explosives have a short life and a low-temperature flame of ignition which renders them comparatively safe in gaseous and dusty mines.)

The original permissibles were of the ammonia-dynamite class, but now some gelatin dynamites also are given the permissible stamp by government regulatory agencies. Trinitrotoluene, generally known as TNT, was compounded in Europe in 1907 or 1908, and the du Pont Company, which started working on it in 1909, first produced it in volume in 1911. Hercules Powder and others took up its manufacture during the first World War, when it went into most of the warheads of explosive shells, mines and torpedoes used by the United States forces. With the exception of TNT, all the aforementioned explosives, regardless of their names or functions, still include nitroglycerine as an important ingredient.

The advent of high explosives brought about an important change in the case of ordnance. Not only was powder replaced by TNT in explosive charges but it was discarded as the propelling agent in firearms when smokeless powder was introduced. William C. Peyton, of the California Powder Works, is reported to have produced the first successful smokeless powder for firearms in 1893, and it was immediately adopted by the U. S. Army. Prior to that time, the Naval Torpedo Station at Newport, R. I., had experimented with this more efficient propellent, and later played a major role in its refinement. It is a high explosive far removed in formula and performance from historic gunpowder but closely related to it in physical characteristics. Basically it is a guncotton of low nitrogen content. Its nonsmoking quality is of importance in warfare because it does not give gun positions away to the enemy. Furthermore, approximately 65 percent of the energy of the charge that was wasted in black smoke is now mostly saved and is an effective propulsive agent.

An interesting departure in explosives for military purposes was made in the period from about 1883 to the end of the century when pneumatic guns were developed for propelling high-explosive projectiles such as large-diameter shells and torpedoes. Compressed air was used to start the projectiles on their flight without detonating the explosive in their warheads. The guns ranged in size from 4-inch cannon to 15-inch brutes firing 600-pound charges, and several ships

and coastal batteries were armed with them. About the turn of the century, refinements in technique for projecting charges with explosives resulted in longer ranges than were possible with compressed air. As a consequence, the pneumatic method was retained only for launching torpedoes and for the several pneumatic-gun installations then in service.

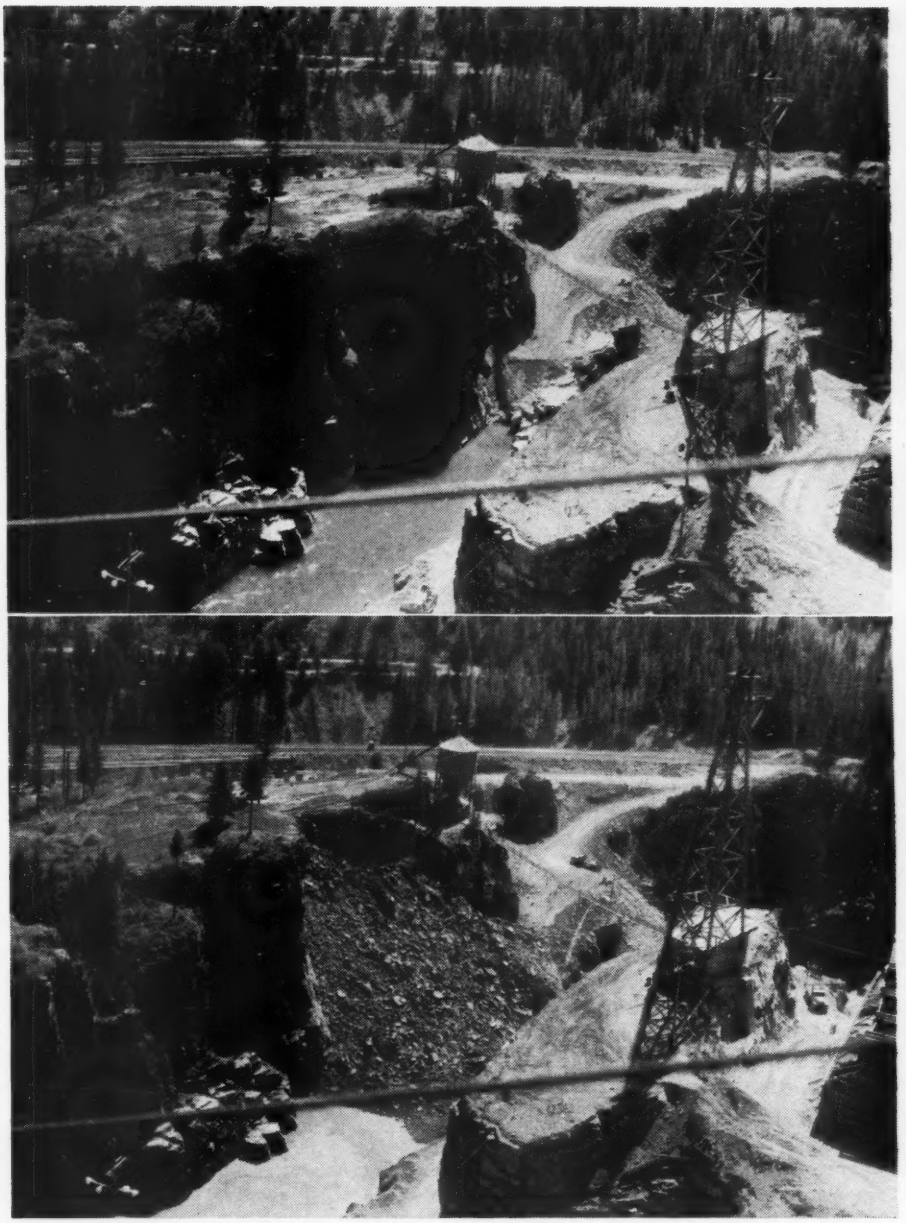
Today the manufacture of explosives is a highly integrated, scientifically guided industry that is fundamental to the welfare and progress of every nation. The United States used approximately 600 million pounds of commercial explosives in 1948—about 95 percent of it in the form of some 200 special types of dynamite made at a dozen or more points throughout the land in plants of E. I. du Pont de Nemours & Company, Hercules Powder Company, Atlas Powder Company, American Cyanamid Company, Trojan Powder Company, Illinois Powder Manufacturing Company, three subsidiaries of Olin Industries, Inc., and others.

To produce these explosives, the concerns consumed, among other ingredients, about 120 million pounds of sodium nitrate, 240 million pounds of ammonium nitrate, 16 million pounds of wood pulp, 100 million pounds of sulphur, 26 million pounds of paper, some 150,000 tons of nitric acid and approximately 75,000 tons of sulphuric acid. By adding the outlay for plants and workers required in the making, treating and transporting of these raw materials and in the manufacture of a host of accessory blasting equipment to that incurred in the actual production and distribution of the explosives, we begin to see that a large share of the nation's economy is based upon the explosives industry.

Industrial explosives can be classed as straight, gelatin and ammonia dynamites, permissibles and others that do not depend on nitroglycerine. Among these are nitrostarch-based dynamites and a relatively new series of blasting agents that is characterized by an exceptional degree of safety in field use and made only in large diameters by special processes. Absorbent fillers are active bases such as sawdust, wood pulp, starch and sulphur. And touchy, dangerous fulminate of mercury in blasting caps has been replaced by stronger, safer and less expensive compounds such as tetryl-lead azide, hexanitromannitol, dinitro-diazo phenol and penta-erythritol tetranitrate. In making and handling materials with such latent destructive potentials, the greatest skill and precaution must be exercised, and the industry is to be commended for its remarkable safety record which compares favorably with that of other large industrial operations.

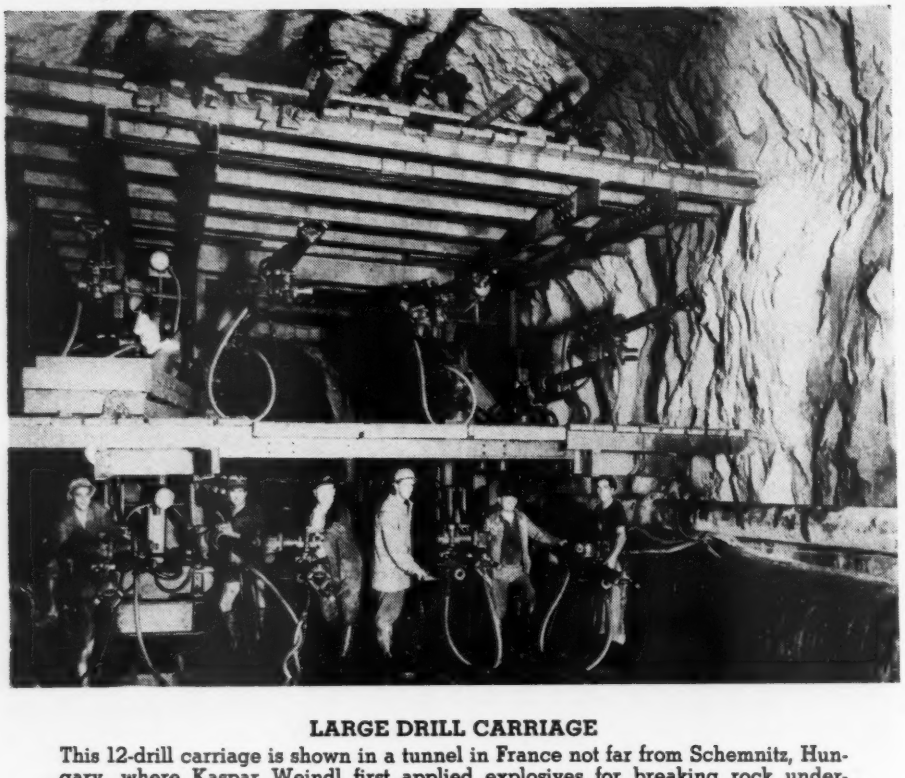
The domestic consumption of commercial dynamite in recent years has been distributed, roughly, as follows: Construction work, 20 percent; metal mining, 20 percent; coal mining, 40 percent (along with a few million pounds of black powder); other nonmetallic mining, 20 percent. Among the minor-volume but important uses of dynamite are stump blasting, ditching, razing buildings, salvaging iron from ships, and seismic exploration for petroleum. Leading in application is the ammonia-dynamite type which is in great demand for mining iron ore and coal, quarrying, and in the construction field. Next in importance is gelatin dynamite, which is used for most metalliferous mining operations and tunneling of all kinds. Because of its water resistance and plasticity, it is readily adaptable to the varied conditions encountered in work of this nature. In a tunnel driven in 1835 with the aid of black powder, 1½ to 2 feet of rock was broken with each blast. In the Hoosac (railroad) Tunnel in 1873, using nitroglycerine, an advance of as much as 42 inches was made per shot. Today, with gelatin dynamite, similar tunnels are driven at an average rate in excess of 10 feet per blast.

With approximately 200 types of blasting agents on the market, the modern engineer can choose one suited to his



READY-MADE COFFERDAM

These are the first and tenth photos of a three-a-second machine-gun series. Three seconds elapsed between their taking. They show a cofferdam that was thrown across a deep gorge at Clark Fork, Idaho, by Morrison-Knudsen Company to divert the stream through tunnels around the site of a dam being constructed below that point. The explosives were placed in coyote holes (small adits) driven into the cliff and fired by millisecond-delay (some makers call them short-period or split-second delay) electric blasting caps. The latter permit firing in sequence multiples of 25-50 milliseconds instead of the normal 1½- to 2-second intervals.



LARGE DRILL CARRIAGE

This 12-drill carriage is shown in a tunnel in France not far from Schemnitz, Hungary, where Kaspar Weindl first applied explosives for breaking rock underground in 1627. Powerful boring equipment like this and high explosives were developed hand in hand. Working together, they make it possible to advance tunnels of large size more than 10 feet per blast. The drills are Ingersoll-Rand DB-35 drifters with 48-inch aluminum shells mounted on DJB booms.

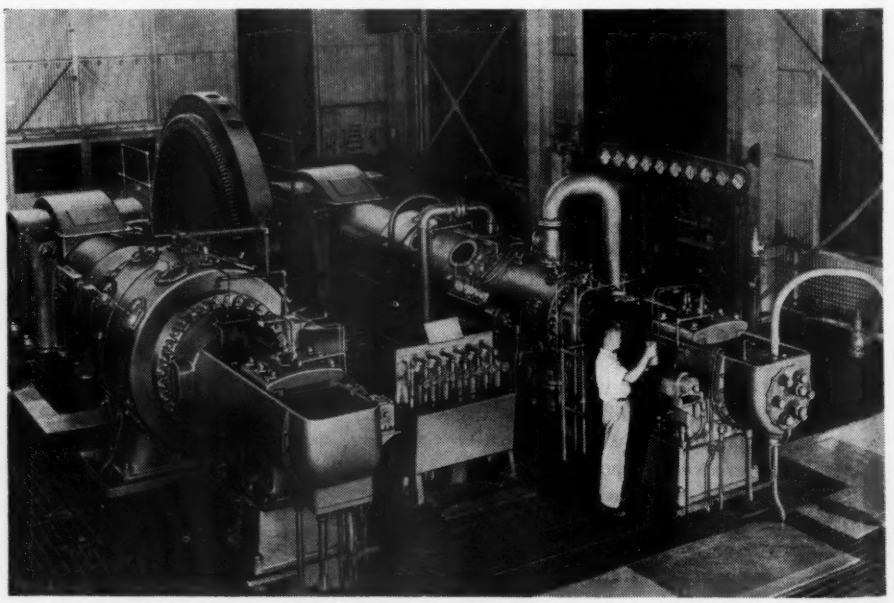
special needs. Well-nigh any imaginable combination of strength, velocity, size and shape is at his disposal, as is a large range of detonators, fuses, and other accessories. Now demolition jobs and rock excavation can be carried on safely in the immediate vicinity of plants, homes and the traveling public. With such control it is possible to achieve feats of engineering that could hitherto not be accomplished.

The Saguenay River in Canada was recently dammed for a hydroelectric project without the use of the conventional cofferdam. The 95-foot-high, 45-foot-wide steel and concrete dam was constructed completely out of water, standing upright on end on a bank of the river. With tolerances measured in inches, the supports were expertly blasted away in such a way that the dam was seated squarely on the target on the river bottom five seconds after the blast.

Another example of precision blasting is found in the case of explosive rivets where a light charge in the fastener expands the metal to form the riveted end. Gutzon Borglum used 6000 pounds of dynamite and 40,000 detonating caps to sculpture the features of Washington, Jefferson, Lincoln and Theodore Roosevelt in the rock face of Mount Rushmore, South Dakota. He exploded charges as small as a quarter of an ounce, and often a single blasting cap served his purpose.

A new technique, fathered by D. M. McFarland of Atlas Powder Company and variously termed short-period, split-second or millisecond-delay blasting has led to even closer timing in detonating individual charges. The key to the method is an electric blasting cap that is fired from a common circuit in sequence multiples of 25-50 milliseconds instead of the normal 1½- to 2-second intervals. This extremely short period between individual explosions in a series of adjacent holes results in greater than normal fragmentation, less seismic action, closely controlled "throw" and other advantages. Standard delay blasting caps permit timing individual charges so that each one acts upon a free face, but they are not built on the highly important mutual-assistance principle upon which the new electric caps are based. First introduced in quarrying, the technique is now winning favor in many mining operations as well as in large and small outside construction jobs. From a public-relations standpoint, split-second blasting is a boon to the contractor and quarryman because people have accepted blasting in confined, built-up areas knowing that there will be no "fly-rock" and little concussion.

This brief review of the history of explosives may help us more fully to appreciate statements made in 1922 by T. W. Bacchus, vice-president of the Hercules Powder Company, in an address titled, *Dynamite—The New Aladdin's Lamp.* To quote: "Aladdin's lamp, when rubbed, gave its owner anything he desired — silver, gold, precious stones, fine buildings, and fair gardens. Dynamite also does the bidding of man and causes Nature's vast stores to yield their treasures." And, without much reflection, one might agree with the chemists who claim that much can still be learned in explosives manufacture and application. After all, in exploding dynamite we are merely splitting molecules in an age when splitting atoms is in vogue.



HIGH-PRESSURE COMPRESSOR

This machine compresses gases to 15,000 psi, which exceeds the pressure of the water at the bottom of the greatest ocean depth—6½ miles down. A boxcarful of gas is taken into its first-stage cylinder every minute. It enters through a 20-inch pipe, while the compressed gas is discharged from the final cylinder through a 1-inch pipe. The unit is one of six Ingersoll-Rand 7-stage machines used by the Hercules Powder Company for compressing a mixture of nitrogen and hydrogen in making ammonia for ammonia dynamites.

A Little Air May Do the Job

Wilbur G. Hudson

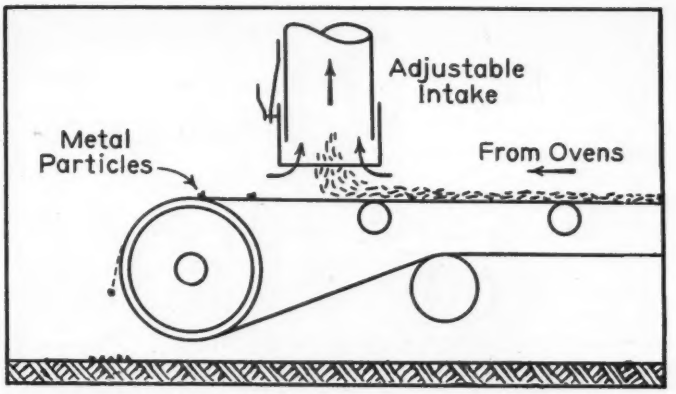


FIGURE 1– REMOVES METAL
Setup for removing tramp metal from macaroni. An air current carries the food product upward while the heavier metal continues, falling off at the end of the belt.

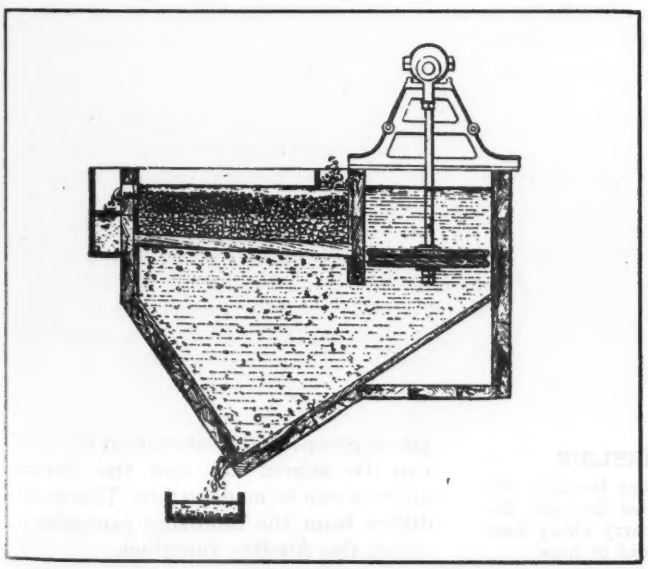
THERE are some odd applications of air power in the materials-handling field. Some are not so good as mechanical methods, some are much better. The writer recalls a device for moving flat cast-iron slabs from one end of a foundry to the shipping room. A double-bottom, slightly downgrade trough extended along the floor of the building. The false bottom was pierced with ⅞-inch holes. Registering with these were 1-inch balls with retainers holding them in position to leave the holes slightly open. Air at 2 pounds pressure was introduced into the compartment and lifted the balls so that all the holes were plugged. But when a slab was laid in the trough, the balls beneath it were pushed down and the air jetting through lifted the slab slightly so that it floated along, "airborne" to the far end. As it moved, the holes at the incoming edge opened and those left uncovered immediately closed to cut off unnecessary jets. The installation, which was in a large Pittsburgh foundry, worked perfectly, and it had the added feature of cooling the slabs in transit. However, there are mechanical conveyors that can do the job better.

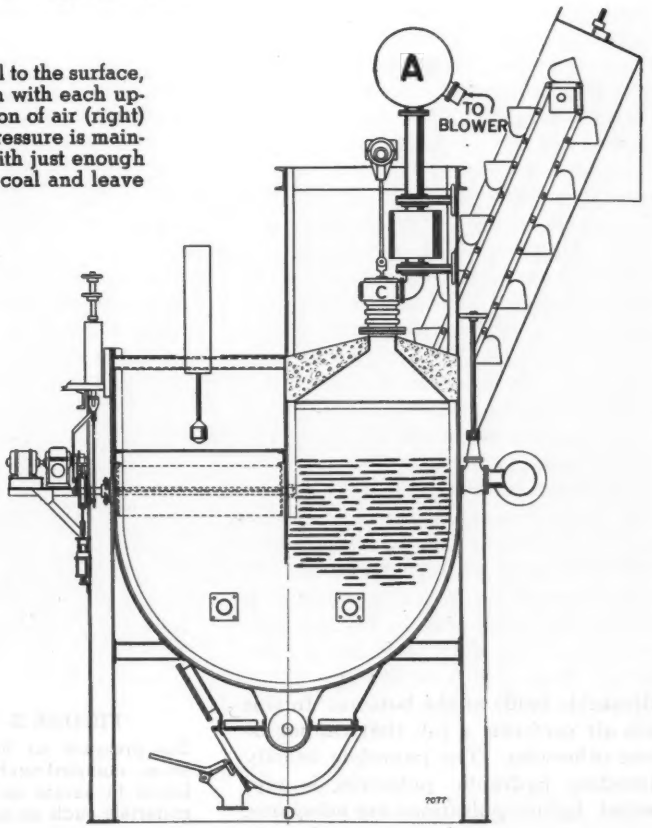
An instance where air does the job nicely involves the removal of any small nonmagnetic metallic particles that might be caught in elbow macaroni. The food comes from the ovens in lengths of an inch or so and is dropped on a slow-moving belt conveyor to dry and harden. Then it is elevated to an upper-floor packaging department. Should such particles, specifically pieces of monel metal, remain in the product ready for the customer, it might result in costly damages and loss of trade. It is therefore essential that every fragment be eliminated.

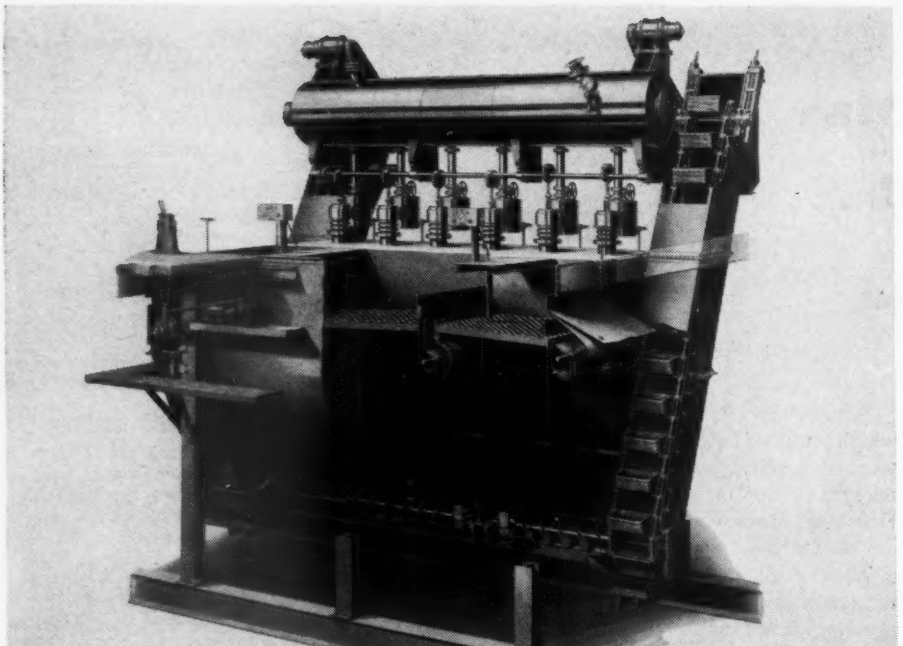
As shown in Figure 1, an adjustable air intake is located closely above the belt near the discharge end and continues up through a separator where the duct connects with an Ingersoll-Rand type constant pressure exhauster. With the intake suitably set, the macaroni is lifted off the belt, but the metallic particles, which the air cannot lift, pass and fall on to the floor. It would be difficult to devise a mechanical method that would function so well.

Present-day methods of mining coal bring to the tipple a large percentage of small sizes and too high a percentage of dirt (often 20 to 30 percent) to be salable. Large sizes can be hand-picked, but mechanical washing of the smaller ones is a must to eliminate the impurities. Originally, this was done by a plunger jig in which the coal is fed over a grid and pulsating surges of water agitate the mass, bringing the lightweight

HYDRAULIC AND PNEUMATIC JIGS
In the hydraulic plunger jig (below) surges of water bring good coal to the surface, where it passes out over a baffle. Efficiency is lost by back suction with each upward stroke of the plunger. By inducing the impulses with a cushion of air (right) the drawbacks of the hydraulic jig are eliminated. Air at 1½ psi pressure is maintained in the expansion chamber *A* and passes through valve *C* with just enough volume to create a pulsation that will lift pure coal and light bone coal and leave the heavier shale and dirt on the bottom.







COAL WASHER

Cutaway section through a Link-Belt air-pulsated coal washer. Water flows continually into the compartments. The coal rises with each air pulsation and works progressively to one end, where it floats off. The refuse sinks and is drawn off.

clean coal to the top to pass over a baffle while the slate, dirt, etc., are rejected.

The plunger jig has serious shortcomings. The downstroke of the plunger raises the mass in the box, but the upstroke creates a back suction, drawing the whole mass down again before gravity can function to separate the light from the heavier particles effectively. Much good coal is carried down with the dirt, and serious degradation of the larger, high-revenue sizes results from the grinding action within the mass. Moreover, adjustment of the surges can be made only by stopping to reset the plunger eccentrics. These drawbacks were eliminated with the introduction of compressed air as the pulsating medium. All back suction and loss of good coal through the bed is avoided by its use, and the tapered or gradual start and stop of each pulsation by an air cushion produces the effect desired. Any necessary adjustments can be made without stopping the washer.

An Ingersoll-Rand centrifugal blower with a capacity of 1000 cfm at 1½ psi maintains the needed pressure in a reservoir or expansion chamber connected with each pulsator unit through a valve. The latter is set to allow the admission of just enough air to create a pulsation of sufficient amplitude to lift the pure coal clear of the sieve plate, leaving the heavier shale or dirt to pass out of the adjustable baffle at the bottom. In this case air performs a job that cannot be done otherwise. The pounding usually attending hydraulic pulsation is prevented, lighter pulsations are adequate, and more efficient separation is secured.

A recent development with far-reaching possibilities is the Airslide by means of which certain materials—notably cement, barite, bentonite, lime, soda ash, gypsum and fly ash—take on the flow characteristics of a liquid. Research by the Huron Portland Cement Company led to the adoption of the fluidizing method in its mill as a substitute for screw conveyors handling bulk cement. As shown in Figure 2, the installation consists of a rectangular trough with a false bottom of especially woven canvas. In the compartment thus formed is maintained an air pressure of 4 to 12 inches (water gauge) by a constant-pressure fan-type blower. The air filters up through the fabric, mixes with the material and carries it along at a rate dependent on the slope. It is strictly gravity flow, so the power requirement is remarkably low.

At the Port Huron plant the eight

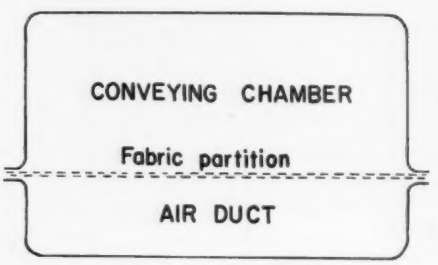


FIGURE 2– AIRSLIDE

Low-pressure air flowing through the lower compartment rises through the fabric to aerate and carry along fine materials such as cement or lime.

original mill-circuit screw conveyors were driven by a total of 200 motor hp. The present Airslides are operated by a single 2-hp fan. The system has other advantages: noiseless functioning, elimination of all risk of injury from moving parts, and adaptability. The air volume per square foot of canvas is said to be 3 to 5 cfm, and the gravity slope varies from 4 to 6.5 degrees. Without aeration it is difficult to make bulk cement flow on an angle of 40 degrees. The capacity of the conveyor is closely porportional to the trough width, which ranges from 6 to 14 inches, and it may be as high as 100 tons per hour. Airslides are also used to withdraw material from a series of storage bins at a fixed rate and to deliver it to an Airslide collecting unit. There are no moving mechanical parts. The feed rate is easily varied by controlling the volume of the air and is stopped by turning off the air supply.

As an indication of the possibilities of this method of transporting bulk material, Figure 3 shows the cross section of a

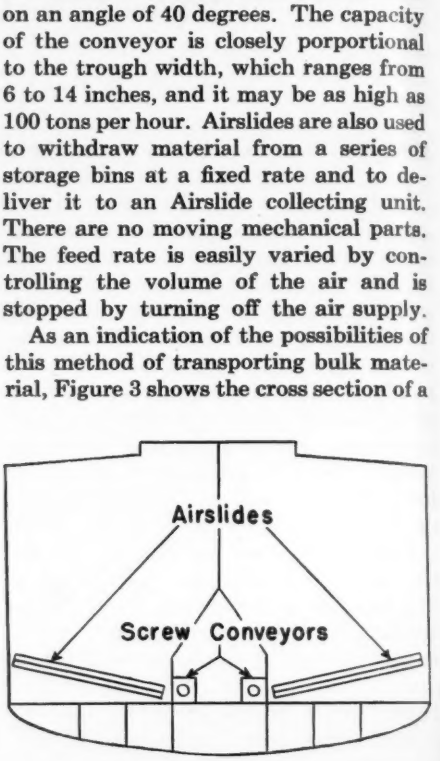


FIGURE 3– SHIP UNLOADER

Section through a steamship equipped with transverse Airslides on 2-foot centers that feed material to two longitudinal screw conveyors.

Huron Company steamship that is equipped with Airslides. These extend transversely on 2-foot centers and discharge on to longitudinal screw conveyors extending along the keel amidships. At the bow, the cement is lifted by a pneumatic conveyor. Air at a pressure of 12 to 20 ounces is furnished by two 15-hp blowers at a rate of 5 cfm per square foot of each partition. As a result of the elimination of the usual steep hoppers and the lowering of the center of gravity of the cargo, the carrying capacity of the vessel has, it is claimed, been increased from 12,500 to 18,000 barrels. The hourly discharge rate is 1350 barrels.

Unfortunately, many bulk materials will not fluidize. Coal, for example, frequently causes trouble by drifting, hanging up in feed chutes and arching in a bunker or silo. Injection of air has little effect, except to the extent that the mass can be stirred up and the portion affected can be made to flow. This action differs from the fluidizing principle on which the Airslide functions.

Making Ice and Bottles in Manila

IN ADDITION to operating a brewery, San Miguel Brewery, Inc., of Manila, P. I., has extensive industrial interests. It manufactures bottles and ice. Although it uses these products in its brewery business, it sells the larger percentage of the output of both plants. The bottle-making factory has recently been enlarged to a capacity of 250 tons of glass per day, which is equivalent to approximately 500,000 bottles. This supply is sufficient to meet the requirements of the brewery and of most of the soft-drink manufacturers in the islands, including the Coca Cola Bottling Works for which the brewery has a franchise.

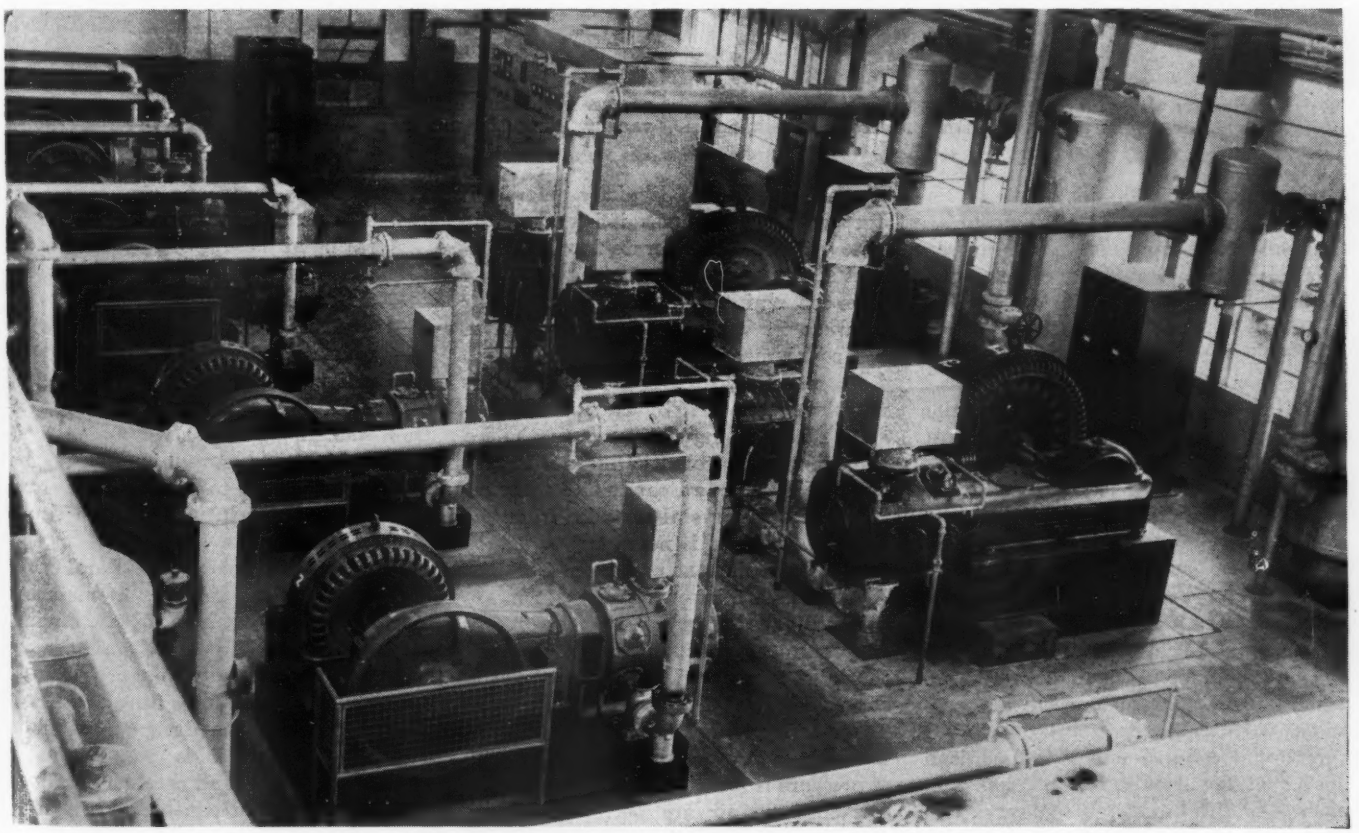
The bottle plant is situated at the mouth of the Pasig River in the City of Manila so that water transportation is near at hand. In the room pictured at the bottom of this page are shown five air compressors and three vacuum pumps which are used in the production of the bottles. The original compressor installation consisted of four single-cylinder units and these were supplemented later with two of the duplex type. All the machines compress air in one stage to 50-psi discharge pressure. All compressors and vacuum pumps are driven by direct-connected synchronous motors.

Ice manufacture is carried on by a subsidiary concern which is known as The Ice & Cold Storage Industries of the Philippines, Inc. Prior to World War II it ran three plants in Manila and was planning to build a new and larger one. Those plans had to be postponed because of the fighting. All of the existing establishments were badly damaged during the battle for the liberation of Manila. As soon as hostilities ceased, their rehabilitation was begun and the program for new construction was revived. During the intervening years the fourth plant has been completed and put into successful operation. It has a capacity of 400 tons of ice a day.

Because the fishing industry is the biggest individual customer of the ice company, the new plant was located near the outlet of the Pasig River where fishermen could be readily served. Known as the Farola Ice Plant, the building covers a ground area of 5300 square meters (57,048 square feet) and is supported by more than 1200 timber piles which extend into the soft ground a maximum distance of more than 50 feet. The structure is divided into three main sections: power plant, ice-manufacturing section, and ice storage room.

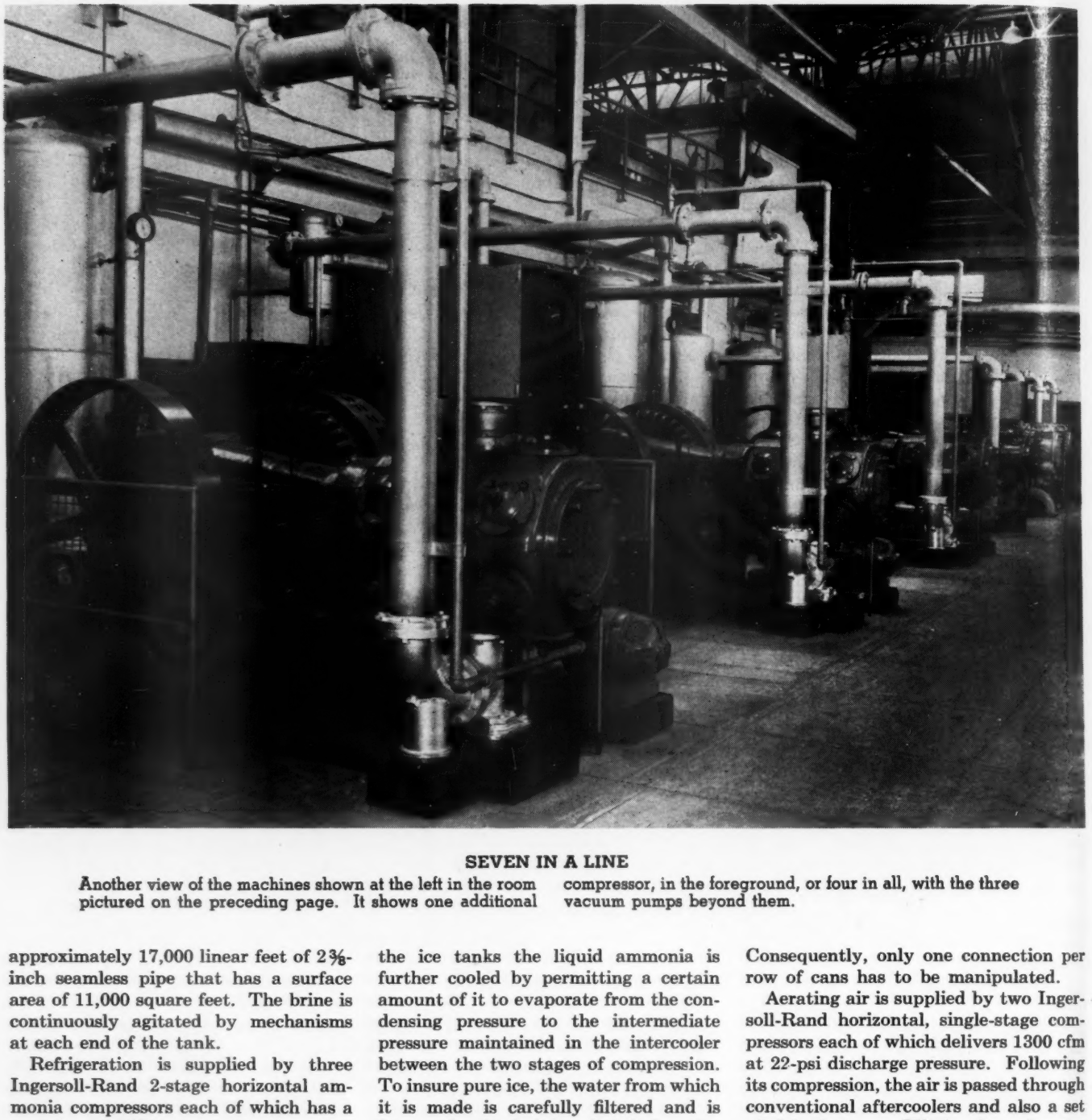
In the ice-making section there are four freezing tanks each of which contains 1248 ice cans of 300-pound size. These are arranged in 48 rows of 26 cans each. To facilitate handling them, the cans are placed in baskets, each holding thirteen cans so that there are two baskets to the row. After the manufacturing cycle has been completed, the cans are lifted out, a basket at a time, by an electrically driven crane. They are momentarily dipped in warm water to loosen the ice from the sides. The cans are then upended by means of a hydraulic dumping mechanism that discharges the blocks of ice onto a conveyor that carries them either to the loading platform or to the storage room. The latter has a capacity of 14,000 blocks, and these are stacked eight high by a high-speed tiering machine.

The ice is formed by circulating brine around the cans that has been cooled to a low temperature by an ammonia-refrigeration system. Extending across each tank, at the center, is a 20-inch combination suction header and accumulator and a 12-inch liquid header. The latter carries liquid ammonia, which goes out into coils that are placed at various levels in the tank between the rows of cans and are in the form of hairpins that extend back to the suction header. By this arrangement the temperature is distributed uniformly throughout the tank. The coils consist of



COMPRESSOR ROOM OF BOTTLE PLANT

At the right are two Ingersoll-Rand duplex, single-stage air compressors each driven by a 300-hp motor. At the left are three I-R single-cylinder units, and beyond them three vacuum pumps. Compressors discharge at 50 psi.



SEVEN IN A LINE

Another view of the machines shown at the left in the room pictured on the preceding page. It shows one additional compressor, in the foreground, or four in all, with the three vacuum pumps beyond them.

approximately 17,000 linear feet of 2⅜-inch seamless pipe that has a surface area of 11,000 square feet. The brine is continuously agitated by mechanisms at each end of the tank.

Refrigeration is supplied by three Ingersoll-Rand 2-stage horizontal ammonia compressors each of which has a capacity of 297 tons at 20-psi suction pressure and 200-psi discharge pressure. Each machine is directly driven by a Westinghouse 450-hp synchronous motor. The compressors are equipped with regulators that permit them to be operated at ½-, ¾-, or full load.

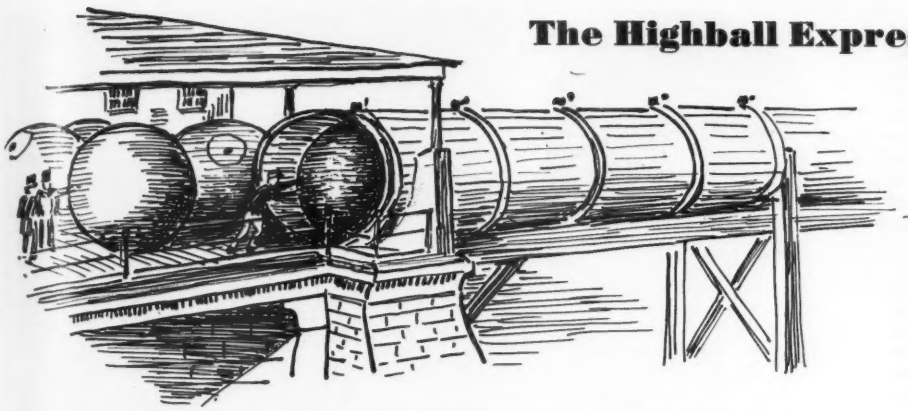
The compressed ammonia gases are liquefied in three horizontal shell-and-tube type condensers each of which has a cooling surface of approximately 3000 square feet. The condensers are provided with cooling water by four I-R centrifugal pumps, one of which is a spare, having a capacity of 1200 gpm each. In the interest of conservation, the condenser cooling water is recirculated over a 3-unit Fluor counterflow, induced-draft cooling tower. After leaving the condensers and before reaching the ice tanks the liquid ammonia is further cooled by permitting a certain amount of it to evaporate from the condensing pressure to the intermediate pressure maintained in the intercooler between the two stages of compression. To insure pure ice, the water from which it is made is carefully filtered and is frequently checked by chemical analysis. Before being delivered to the ice cans through automatic fillers it is precooled to 50°F in a Beaudelot forecooler.

To produce crystal-clear ice from undistilled water it is necessary to aerate the water during the process of freezing. A so-called high-pressure system is utilized for this purpose, and the air has a pressure of approximately 15 psi at the inlet to the can. This system was chosen because it requires considerably less manual labor than the commonly used low-pressure one. Where the higher pressure is resorted to, the drop tubes carrying the air are permanently installed in the ice cans, and those in all thirteen cans in one basket are connected to a common header, which is also permanently fastened to the basket. Consequently, only one connection per row of cans has to be manipulated.

Aerating air is supplied by two Ingersoll-Rand horizontal, single-stage compressors each of which delivers 1300 cfm at 22-psi discharge pressure. Following its compression, the air is passed through conventional aftercoolers and also a set of dehydraters. Elimination of water from the air is important because, if present, it might contaminate the ice. Care is therefore taken to make sure that the dehydrating apparatus functions properly at all times.

Power for operating the Farola Ice Plant is generated on the premises by four diesel engine-generator sets having a capacity of 4800 hp. It has been in service for a little more than a year, and the results achieved have fully sustained the promises of the designers. They have shown that it is possible with modern machinery and skillful operation to produce ice that can be sold for less today than before the war even in the face of sharply increased and continually rising costs of equipment, materials and labor.

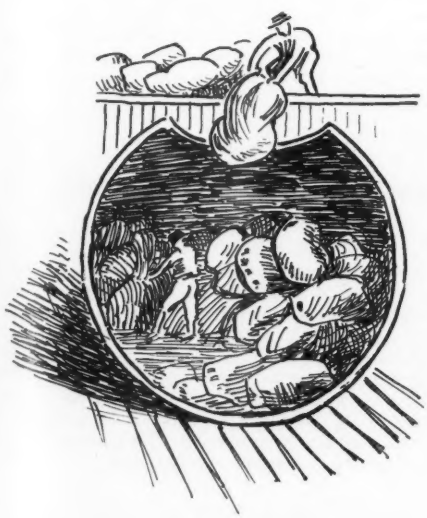
The Highball Express — Brisbane's Dream



PUSHING SPHERE INTO TUBE AT TERMINAL STATION

NEARLY eighty years ago, Albert Brisbane, of New York City, proposed a new, fast method of transporting mail and freight. His idea was to set up systems of large pneumatic tubes between cities, just as we now have pipe lines for oil, gas and water, and send the merchandise through them in metal spheres up to 10 feet in diameter. Locomotion at the tube terminals was to be induced by air suction, creating a vacuum pull. A similar pneumatic-tube system is used today in many department stores to transport cash and orders from counter to cashier, and return receipts and change to the clerk.

A globe, Brisbane said, is the true and simplest form of motion. "It revolves on its periphery without friction, is moved with the least power, and permits the highest rate of speed obtainable by any form of ponderable or material body." Nature, he pointed out, uses the sphere in all her works, from planets to falling raindrops. He visualized cast steel for the smaller shells and boiler iron for large ones turned in a lathe to insure precise contours. Any size from 2 feet to 10 feet in diameter would, he believed, be suitable. Manholes with covers that screwed flush with the surface of the sphere would permit loading and unloading.



STOWING FREIGHT

Advantages of this novel form of transport were, as Brisbane saw it:

1. An even, smooth, solid roadbed.
2. A passageway free from dirt and dust and action of wind, rain and snow.
3. Spheres moving with a forced current of air would not be impeded by air resistance.

The tubes were to be constructed of wood a little larger in cross section than the containers they were to carry. A slightly concave metallic rail or plate was to serve as a roadbed. The tubes were to be placed under or above ground, but Brisbane thought it would be best to mount them on posts or piers about 15 feet in the air. He was of the opinion that the rolling globes could travel up to 200 miles an hour, which was much faster than man or freight had ever managed to move, and this is more or less true today, except for aircraft.

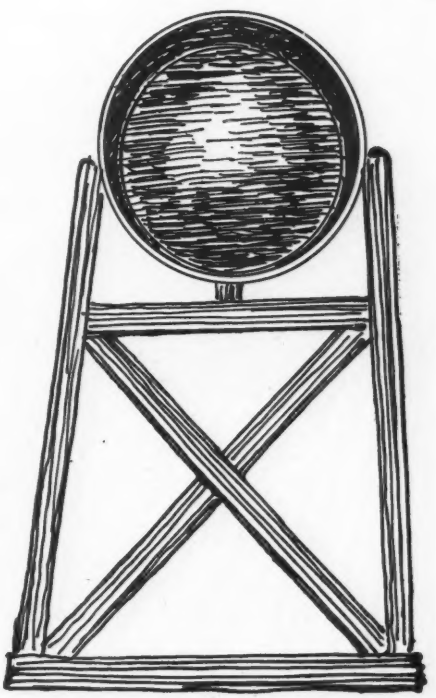
According to Brisbane's estimates, a line could be constructed for one-half or one-third the cost of a railroad. Besides, a sphere 5 or 6 feet in diameter made of ½-inch steel would come to less than a pair of cast-iron car wheels. To stop a globe he planned to use a series of brakes in the top of each tube. These were to be held down by springs, and 50 of them, presenting a large striking surface that the sphere would have to push up out of the way, might do the trick, he figured. Apparently, this kind of transport has never been tried; but in our day of pipe lines all over the country it doesn't sound too fantastic.

Possibly, the huge speeding spheres would make a terrific noise in overhead tubes of wood. Boys with .22 rifles might perforate them and thus reduce their pneumatic effect on which the movement of the spheres would depend. Mischief-makers or saboteurs might set fire to them. But an underground network of reinforced-concrete tubes—a system of intercommunication between cities—might be feasible and would be hard to disrupt by any means and easy to protect.

Apparently, the cost of such tubeways, equipment and installation would be the principal consideration. Air pumps could, undoubtedly, be operated more cheaply than steam or diesel locomotives, and wear would not be much of a problem. Brisbane further pointed out that when a sphere is underway, the merchandise in it would be held immobile by the centrifugal force of the rolling motion. And to prevent too much jolting of the freight at starts and stops, he thought some sort of compartments or fasteners would be in order.

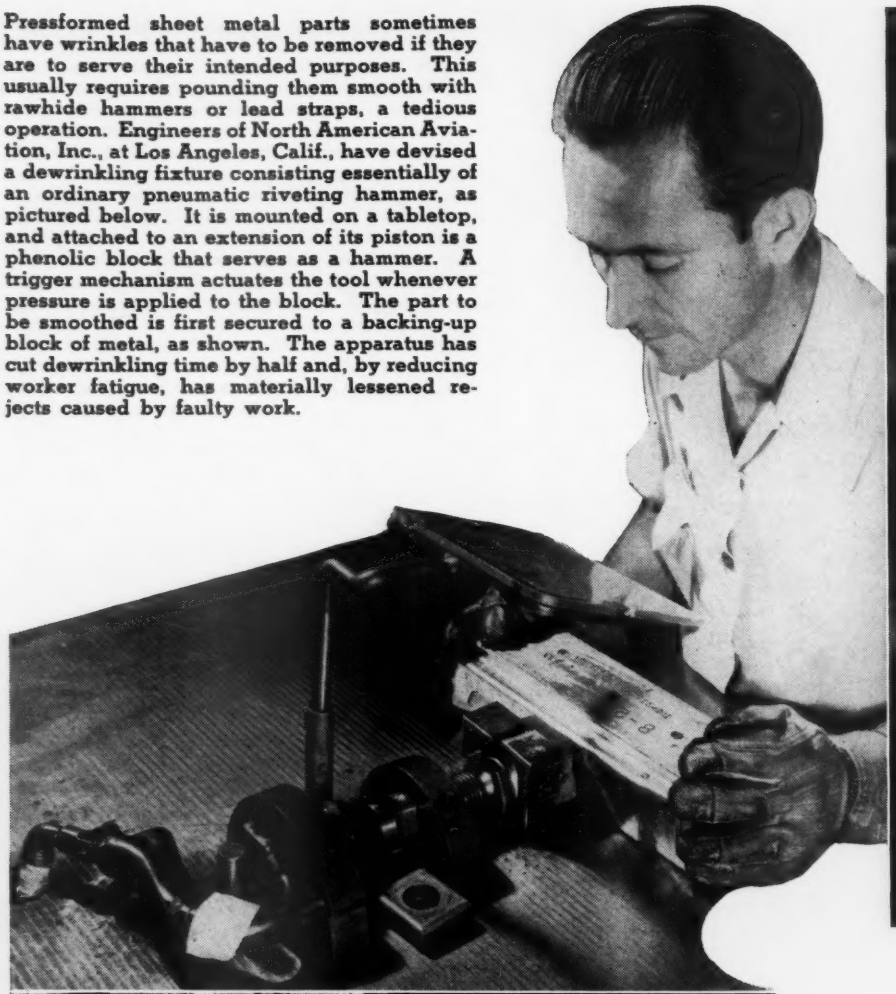
Operating costs, Brisbane argued, would be small as compared with those of railroads. For instance, a train of 100 spheres, once it was on its way, would travel to its destination without an engineer, fireman, conductor, brakeman, switchman or trackman touching or keeping an eye on it.

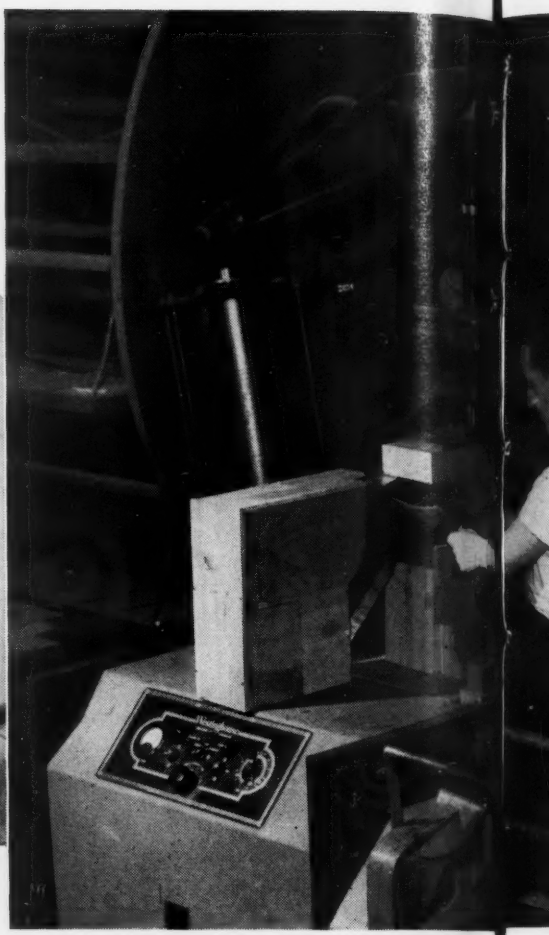
It could be added, in the light of today's outlook, that a fast, safe, underground network of intercommunication between principal cities might appeal to any nation. In emergencies, and with stabilized seats, the spheres might be used to transport passengers. It would probably be like riding a subterranean roller coaster. Too, it might be of advantage to make the spheres of rubber or plastic that would, for example, reduce both wear and noise. It is conceivable that Albert Brisbane, had he been born a few decades later, might right now be signing up intercity franchises, buying rights-of-way and applying for an RFC loan.



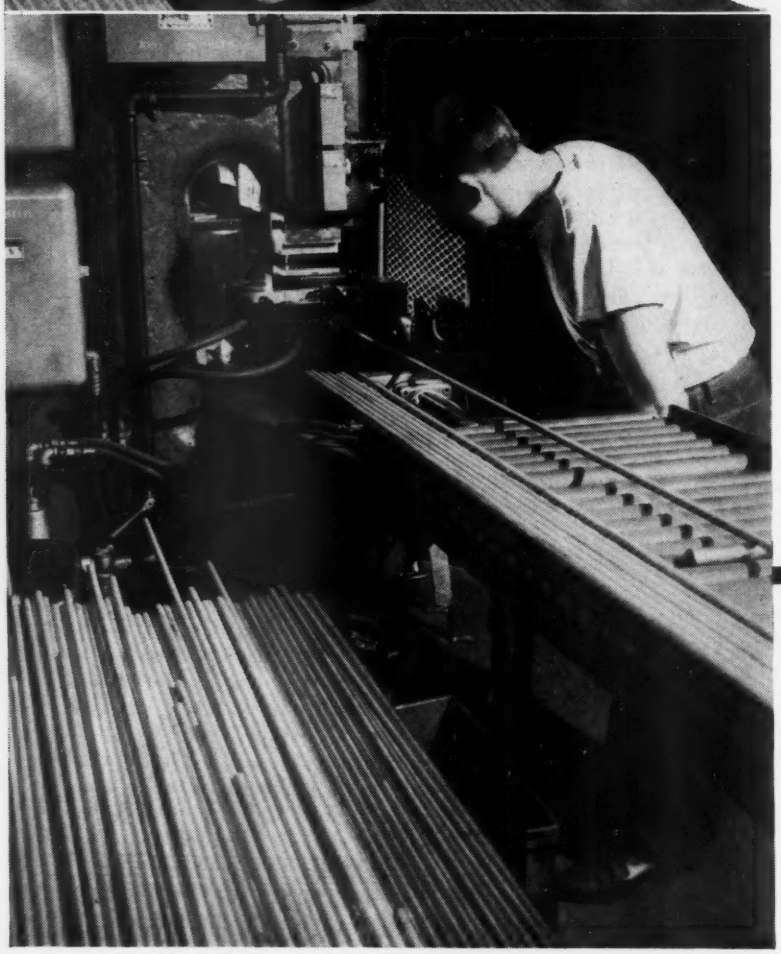
TUBE CROSS SECTION

Pressformed sheet metal parts sometimes have wrinkles that have to be removed if they are to serve their intended purposes. This usually requires pounding them smooth with rawhide hammers or lead straps, a tedious operation. Engineers of North American Aviation, Inc., at Los Angeles, Calif., have devised a dewrinkling fixture consisting essentially of an ordinary pneumatic riveting hammer, as pictured below. It is mounted on a tabletop, and attached to an extension of its piston is a phenolic block that serves as a hammer. A trigger mechanism actuates the tool whenever pressure is applied to the block. The part to be smoothed is first secured to a backing-up block of metal, as shown. The apparatus has cut dewrinkling time by half and, by reducing worker fatigue, has materially lessened rejects caused by faulty work.



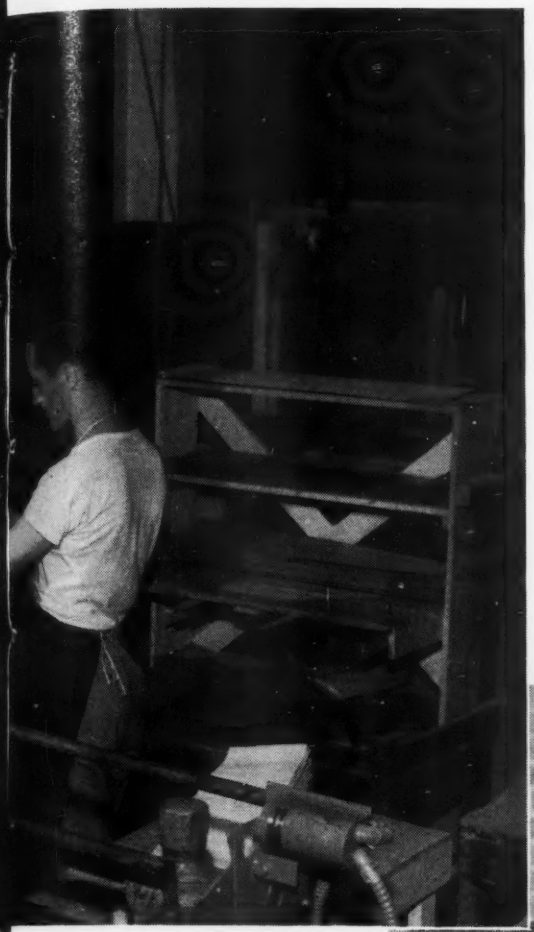


COMPRESSED AI T



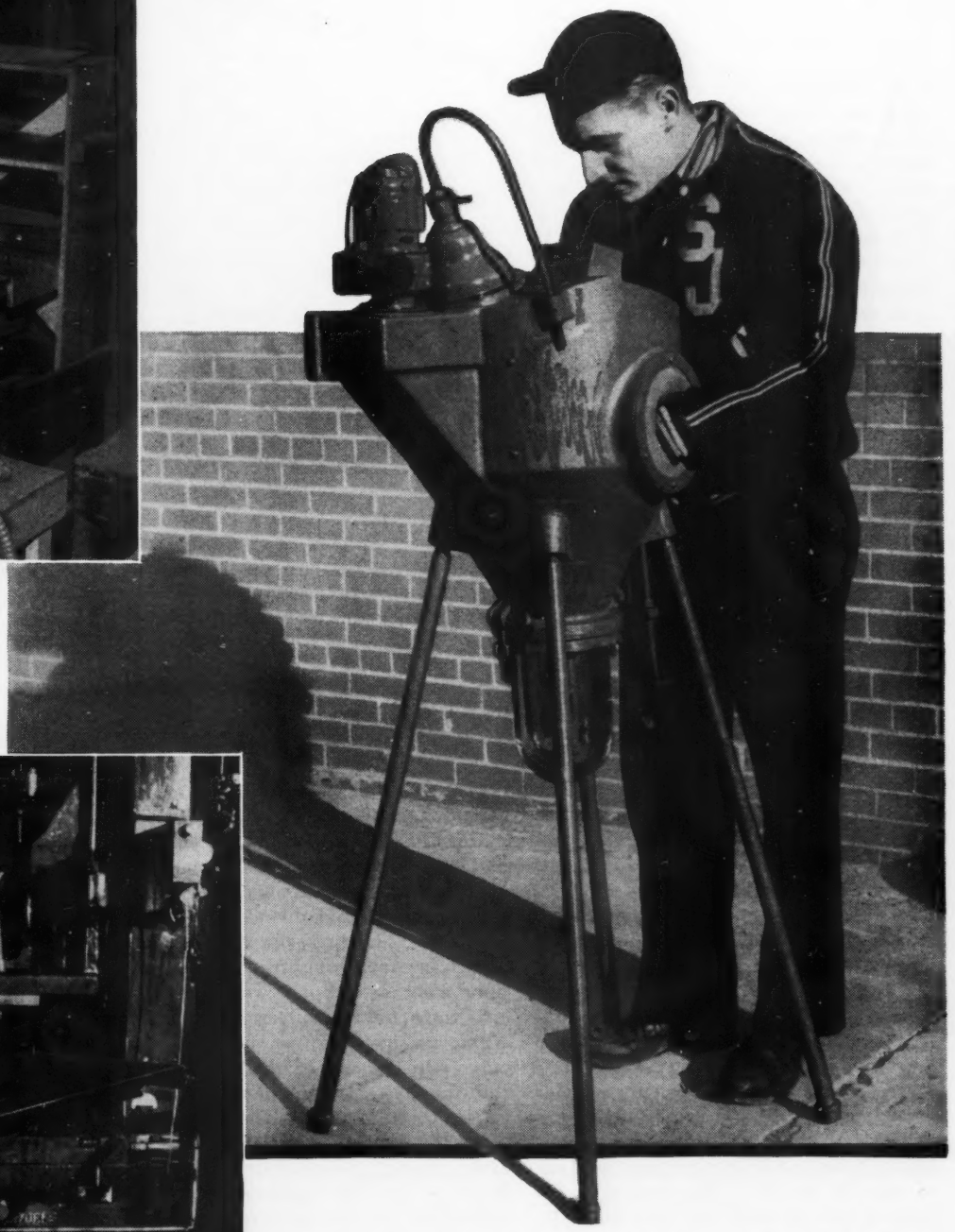
Blades for compressor sections of General Electric turbojets are forged from stainless-steel bars of suitable length sheared from long pieces in a press (left). Shown here is a length being fed into a circular holding die. When a button is pressed, an air cylinder on the feed carriage left of the die causes fingers to grip the stock. This trips a microswitch that operates a second cylinder (below stock) to move the bar an adjustable but exactly set distance. This action causes a second microswitch to actuate a third air cylinder, thus clamping the stock in the die and tripping the press. Each feeding stroke ejects the previously sheared piece, and the cycle is repeated automatically until a stop button is pushed or the end of the bar is reached.

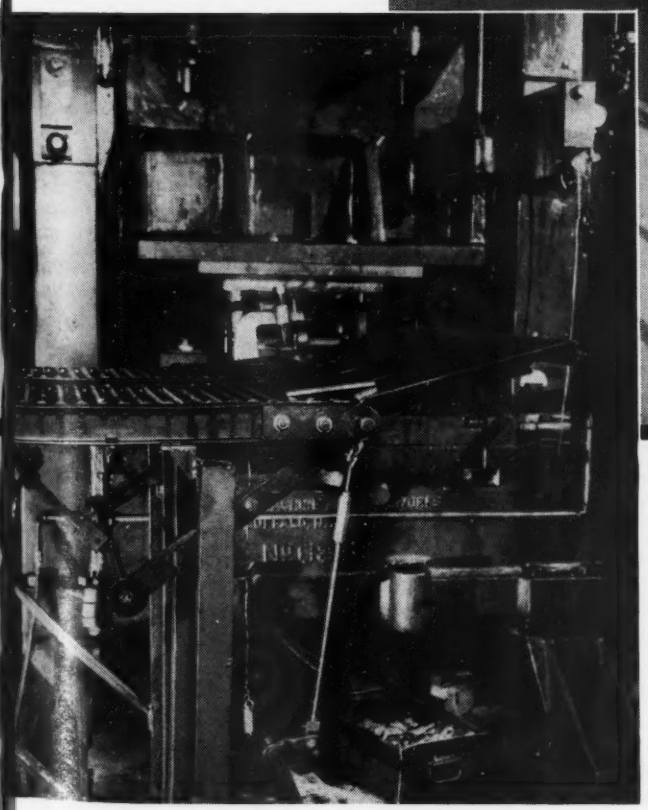
After a frame plate for an electric-motor stator has been cut to length and punched in the press shown at the right, a steel shelf in front of the press is tilted to slide the plate onto a roller conveyor for delivery to a coining press. Tilting is done through linkage by the piston of an air cylinder (partially visible under the conveyor at the left edge of the picture). The operation is interlocked with the motion of the press for automatic sequencing. The installation is in the Buffalo, N. Y., plant of Westinghouse Electric Corporation.



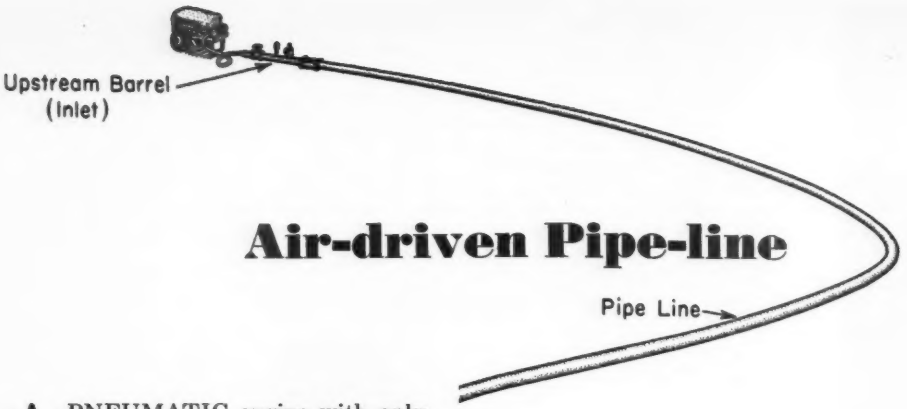
By means of a high-frequency current that dries adhesive quickly, three layers of shaped plywood are bonded securely in 90 seconds to form part of a chime-clock case at Seth Thomas Clocks, Thomaston, Conn. (Picture at left). The work is done in a press actuated by a Hannifin air cylinder. The radio-frequency generator used was supplied by Westinghouse Electric Corporation. By the method previously practiced, it took four hours to air-dry the material on the rotary rack shown in the background.

AI T WORK





The Pangborn midget liquid-blast cleaning unit pictured above works like larger models and extends their benefits to such fields as garages, jewelry-making establishments and dental laboratories. Abrasives as fine as 500 mesh are made into a slurry in a glass bowl in the base of the equipment and applied to the work through blast nozzles while the operator manipulates the piece and observes the progress of the blasting operation through a window. Tolerances can be held to within 0.0001 inch. One of the leading uses of the outfit is preparing dental plates. Compressed air is admitted through a ¼-inch hose, and consumption at 80-psi pressure is at the rate of 5 to 20 cfm. With an aluminum housing, the machine weighs only 40 pounds.



Air-driven Pipe-line Device

Variation of Go-devil Cleans and Coats Interior Walls of Carrier to Combat Corrosion

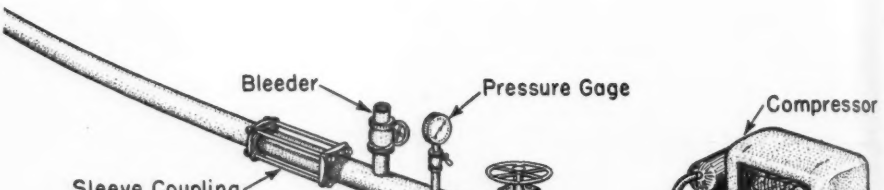
Elton Sterrett

APNEUMATIC engine with only a 4-inch-diameter cylinder and a stroke of more than 7400 feet! Sounds impractical, to say the least. Yet that, in effect, is what was used first to clean and then to coat with a plastic material the inner surface of a 4-inch pipe line more than 1 2/5 miles in length, all without taking up the pipe!

In certain areas of West Texas, for example, the crude oil from the wells carries with it a high content of hydrogen sulphide which, coming in contact with the steel wall of a pipe, sets up extremely rapid and severe corrosion, especially along the lower axis of the line. So serious is this condition that perforation of the pipe's ¼-inch steel shell occurs in a matter of months. Lines without some kind of internal protection must be taken up and replaced almost before the backfill has finished settling.

Where economic reasons such as oil production demand the laying of pipe in such "hot spots," methods must be worked out to safeguard its inside wall against corrosion, insofar as possible, in much the same manner as the exterior surface is now commonly protected. One of the linings that has given excellent results in pipes carrying this highly corrosive crude oil involves the use of various vinyls and polyester plastics. Before these materials can be applied, it is necessary that the wall be thoroughly cleaned, dried and given a prime coat of plastic. When the latter has hardened satisfactorily, a single plastic finish coat is put on and allowed to dry before the system is again placed in service.

To recondition the 4-inch pipe under consideration, the contractor on the job utilized a device based on Curtis-Tomlinson patents and using compressed air as motive power. The section to be treated was drained and cut from the line but left in the ditch with only the ends uncovered. A sleeve of the same diameter as the pipe was attached at each end with compression-type couplings capable of withstanding the pressures to be developed during the workover. Each sleeve was equipped with a drain fitting or bleeder and with a line that was connected, through suitable valves, to a compressor.



GENERAL LAYOUT

Brush and scraper assemblies called go-devils have long been run through oil and gas pipe lines to clean them, being carried along by the stream of fluid. A variation of that technique, with compressed air serving as motive power, was used in this instance to clean a section of pipe and then to coat its interior walls with a protective plastic. The drawing shows how the line was equipped for the work.

Special "pigs" or plugs were employed for all the operations. These, as an accompanying drawing shows, consist essentially of two groups of opposing rubber (Neoprene) plugs without metallic reinforcing and were formed to fit closely within the pipe so as to retain the cleaning material, wiping rags, primer or final coating placed in between them.

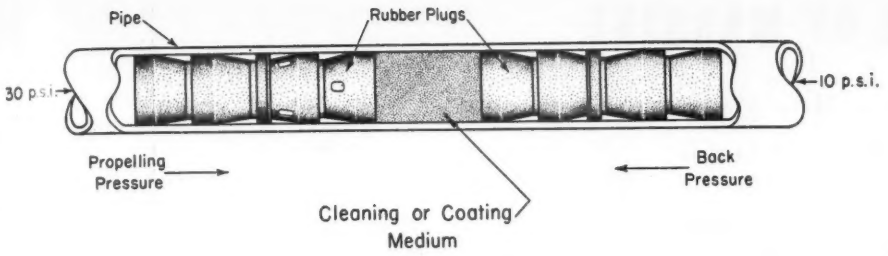
Using the detachable sleeves as loading and unloading barrels, a double plug was run through the line to determine whether or not it was clear of obstructions and free of residual crude oil. Next, a plug or scraper, fitted with circular wire brushes slightly larger than the nominal diameter of the pipe, was passed through to do the initial cleaning. Then the dual plug, fitted with brushes and carrying a batch of cleaning solvent between the two sections, was forced through in the reverse direction and returned to the starting point. Six such round trips were made, solvent being added as needed at the end of a run by pumping it in under pressure greater than that of the compressed air in the line.

Following this thorough flushing of the pipe wall, a single plug, pushing large wads of toiler paper ahead of it, was sent through. On the succeeding trip gunny sacks were substituted for the tissue. These two wiping materials were used alternately until the paper showed the desired degree of cleanliness after removal at the downstream end of the line. All these runs were made in but one direction—that in which the oil is pumped when the system in in service.

The next step involved the use of the plug with steel lathe cuttings and disks between the two sections. The disks carried thin-bladed scrapers which conformed to the contour of the pipe. Six scraping trips were required to insure the removal of all the rust, and each took about thirty minutes. With that work done, the line was tested for leaks by building up the air pressure to 120 psi. The dual plug, alternately conveying toilet tissue and gunny sacks, then made a total of six trips through the pipe.

To get rid of all moisture and to neutralize any sulphur products that might, even after the thorough cleaning, still be clinging to the wall, an amine solution was pushed through the section by aid of the double plug. The net result of the drying and desulphurizing operation was a surface to which the plastic would adhere. Upon completion of this last run the pipe was considered ready for the application of the specified coatings.

Again the dual plug was used, this



SECTION OF PLUG

The plug consists of two groups of Neoprene elements fitting closely inside the pipe and having a space between the groups for the cleaning or coating medium. The sketch illustrates how the rate of travel was controlled by applying different pressures at the two ends. In practice, pressure was initially built up to the same level on both sides of the plug. Then, to move it, air was allowed to escape from the destination end through the bleeder connection shown in the general layout sketch, while the compressor at the starting point continued to supply air to maintain the established pressure. As sketched here, air was bled off fast enough at the right end to reduce the back pressure to 10 psi and was maintained at 30 psi at the left end, thus producing a pressure differential of 20 psi between the two sides of the plug.

time with a batch of 25 gallons of primer solution between the opposing units. Upstream or driving pressure against the plug was maintained at 30 pounds gauge, the downstream valve being set so that transit through the line would take approximately half an hour. Before the removal of the plug at the end of its run, 4.5 gallons of primer had been drained out of the pipe, which was then opened by withdrawing the sleeve. Compressed air was next blown through the line for a period of six hours to dry the primer coat thoroughly.

During the course of the priming operation, rigid precautions were observed against fire or explosion; indeed, this was the case all the while the work of coating was in progress. The finish coat was applied in the same manner as the primer, 30 minutes again being allowed for the passage of the plug, during which time the inner wall was covered with 35 gallons of vinyl plastic. Again the pipe was opened and compressed air used as the drying agent, a 12-hour blow being maintained to remove all solvent from the plastic. After that was done the line was inspected and made ready for service.

The pneumatic method of driving and controlling the speed of the plugs required the use of two portable compressors, each capable of delivering approximately 110 cfm at a pressure of 120 psi. The operating procedure is about as follows: Let us say that a 2-section plug and cleaning material has been placed in the upstream sleeve and the downstream compressor has built up a back-pressure or cushion of from 10 to 30 psi. The upstream compressor is then started and the pressure behind the plug increased to the same gauge reading. In that condition the system is in equilibrium and the plug remains stationary. Its travel is started by bleeding air from the downstream end and by allowing the upstream machine to add air as needed to force the plug through the line. Once the lower end is reached, the procedure is reversed.

To place the amine solution or plastic coatings between the set of plugs, the latter are spotted with the gap between them under the connection to the pump which supplies the liquid. As it is transferred, the forward or downstream plug is forced ahead until the required amount has been introduced. Back or cushion pressure is then built up as before, the liquid gradually feeding out around the trailing rubber plugs and applied to the pipe wall with a squeegee effect. The air pressure acts automatically to take up the space between the plugs as the liquid is reduced in volume.

As to the economies of the Curtis-Tomlinson system of pipe protection, J. K. Alfred, engineer for Shell Pipe Line Corporation, cited the following results obtained in the case of the 4-inch pipe in a paper read before the 1950 annual meeting of the American Petroleum Institute and, later, in a review of the operations before the Houston Section of the National Association of Corrosion Engineers:

"This 7400-foot line was actually lined with plastic in 1949. In the 10 months prior to its coating, 21 leaks occurred from internal corrosion . . . loss of 740 bbl. of oil. Cost of leak repairs, and of oil and damage losses, totalled $2,898. Replacement of line with new pipe, including take-up of the old, would have cost $9,350. Cost of applying plastic coating with the line in place was $1,698 ($0.23 per foot)—which, based on savings from leak reduction, and assuming no increase in leak frequency, would indicate a payout in six months."

Since the plastic lining was applied to the 4-inch pipe, the contractor has successfully coated the inner walls of lines that ranged in diameter from 3 to 12 inches and that had been in service prior to protection for periods of from one to as many as twelve years. Any type of coating is deemed profitable that will extend the life of a pipe line, handling typical sulphide-bearing West Texas crudes, for two years.

Acknowledgment is made to Mr. Alfred and to the American Petroleum Institute for the information on which this article is based and for permission to use the two sketches showing the arrangement of the plug and the method by which it is propelled through the pipe.

Steam Heat from an Atomic Pile

STEAM heat from the world's first atomic-energy furnace in operation is being piped to a building on the grounds of Britain's main atomic-energy plant at Harwell, England. The experimental station that has been constructed there contains an atomic pile operating at a temperature of 1112°F. The heat developed is transferred to a boiler, and the steam raised goes to turbines to generate power. Some of the steam is being used to heat 80 offices where 120 persons are serving as guinea pigs in this first major test of the peaceful application of atomic energy. Care is taken to remove every trace of radioactivity before the steam enters the heating system.

In outward appearance the plant looks like one burning coal, according to a monthly news letter distributed by the United Kingdom Information Office. Cooling towers and chimneys, the latter to carry away exhaust heat, have been retained. In size, also, there is little difference because of the great amount of concrete and lead that was required in its construction to safeguard the workers from the harmful effects of radiation.

The approximate cost of the atomic electric station is $22,000,000, or three times that of a conventional coal-fired plant. However, the latter would consume $45,000,000 worth of fuel during a service life estimated at 30 years, whereas the former would not have to spend a cent for that purpose and would effect a net saving during that period of $30,000,000.

There is an atomic-power steam-electric station in the United States located at Arco, Idaho, that is to be put in operation sometime this year. The source of the energy will be a new kind of reactor in which uranium atoms split into plutonium atoms. Details regarding it are lacking, but it is said to be one of the most important ever developed. With it, the scientists are trying to prove the theory that it is possible by splitting uranium atoms to obtain more plutonium atoms; that is, actually produce more fuel than is consumed originally.

RESERVATIONS BY MACHINE

Electronic Hookup Will Now Help You Get Space on Pennsylvania Railroad Trains

IF YOU have ever approached a railroad ticket office with misgivings born of prolonged waiting, you will welcome the Intelex Automatic Reservation System now installed in the New York Reservation Bureau of the Pennsylvania Railroad. A combination of electronic and mechanical devices, the Intelex System is designed to mechanize wellnigh completely the process of making reservations and to reduce the time previously required for the purpose to about one-third.

The system was developed by International Standard Trading Corporation, an associate of the International Telephone & Telegraph Corporation. Although originally introduced to the public in 1948 as a means of handling air-line reservations, it is also suitable for making reservations for buses, steamships, hotels, theaters—in fact, for any business which deals with the allocation of space. It may also be adapted to facilitate inventory control, the scheduling of machine operations, debit and credit bookkeeping and department-store credit authorization.

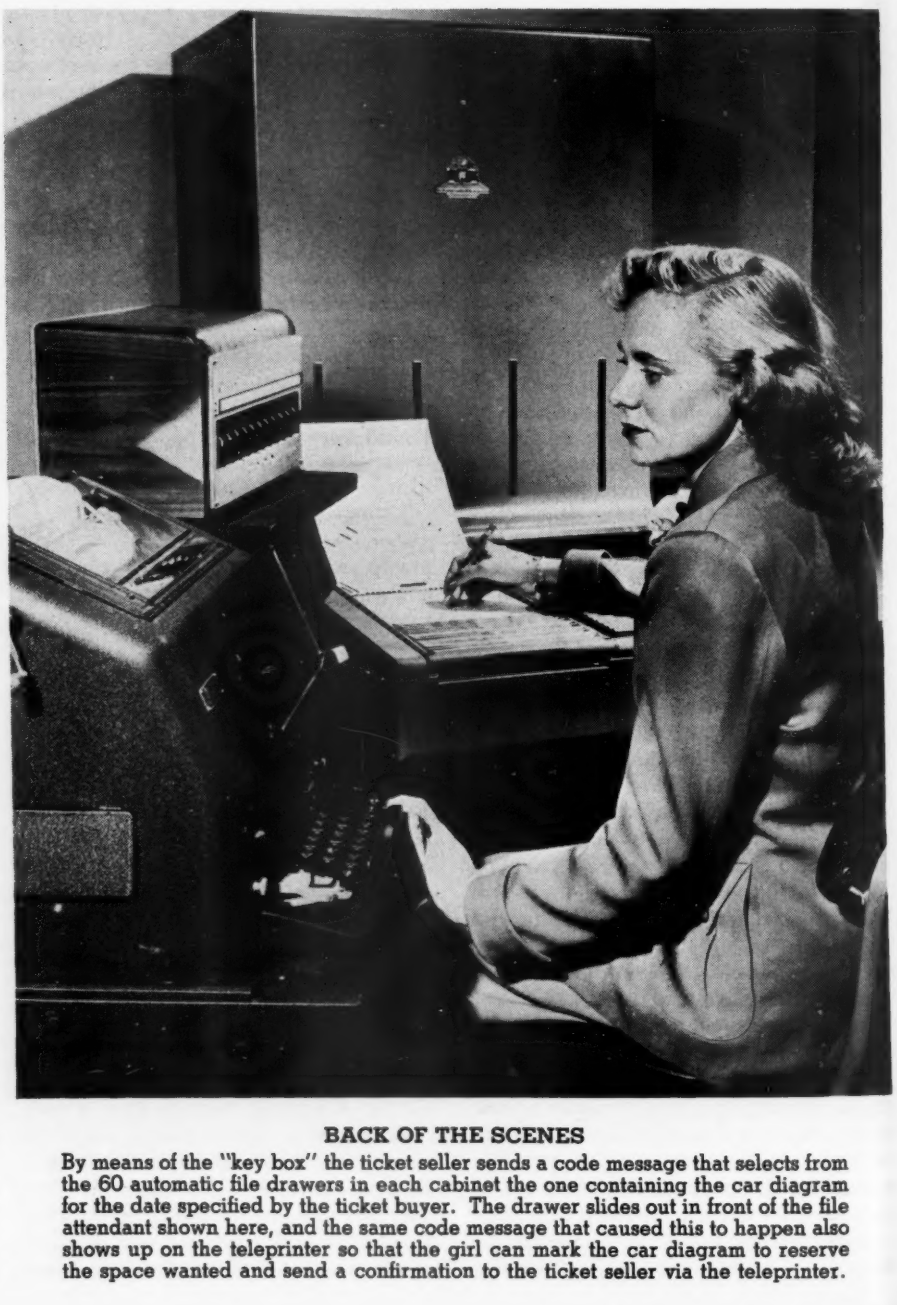
Pennsylvania Railroad officials, who attended the original demonstration of the equipment, believed that it had real value. Consequently, joint committees composed of railway and ISTC representatives worked together to evolve the system that is now in operation at the Pennsylvania Station in New York City. A similar setup is being installed in Philadelphia and, eventually, the entire Pennsylvania Railroad will be served by Intelex.

At first glance, it would seem that the job of making a reservation is not particularly complicated. A customer approaches the ticket seller and asks for a ticket to Chicago, for example. A check of the car diagram may reveal to the agent that he has a choice of several vacancies. The customer designates a preference, and it is recorded on the car diagram and the ticket. It's as simple as that, until you take into consideration the fact that the reservation bureau in New York's Pennsylvania Station is the busiest in the world, handling as many as 30,000 transactions each day. This includes reservations for 6480 sleeping-car accommodations and reserved seats in 427 regular coaches in 79 different trains, and necessitates maintaining more than 25,000 car diagrams in files.

Gratifying as this volume of business is, it occasioned the long waiting period as the ticket seller attempted to get through to the central filing office. When contact was made, the distributor there checked the records, car by car, to determine whether or not the desired space was available. If all had been sold, as frequently happens during holiday- and peak-travel periods, he again canvassed the space status of each car in order to suggest an alternate. As the trains were filled, inquiries naturally became more involved and time-consuming, thus preventing agents and distributors from answering other calls. Furthermore, as there was only one diagram of each car, distributors frequently had to wait their turn. This caused more delay, particularly in filling requests for reservations on the more heavily traveled routes.

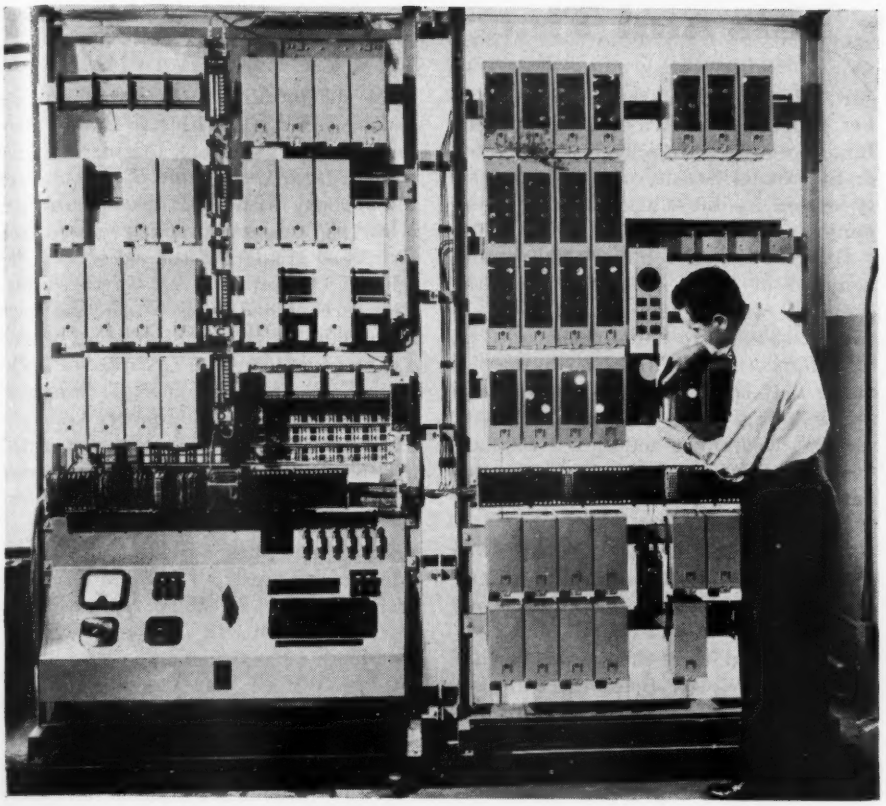
The first requisite of a new method of making reservations was to ease this bottleneck—to provide a system whereby all information about unreserved space would be immediately and simultaneously available to every ticket seller. That was accomplished by a combination of dial-telephone switching equipment and of magnetic recording devices, the former for requesting and the latter for supplying that information.

The dial switching equipment corresponds to an ordinary automatic telephone system, with two notable exceptions: there is no "live" conversation, nor is there ever a busy signal. Instead, by selective dialing, the ticket agent automatically chooses a magnetic recording that gives him the data he needs to fill the request he has received and, in some instances, on alternate space as



BACK OF THE SCENES

By means of the "key box" the ticket seller sends a code message that selects from the 60 automatic file drawers in each cabinet the one containing the car diagram for the date specified by the ticket buyer. The drawer slides out in front of the file attendant shown here, and the same code message that caused this to happen also shows up on the teleprinter so that the girl can mark the car diagram to reserve the space wanted and send a confirmation to the ticket seller via the teleprinter.



FORMIDABLE BUT ACCURATE

The "innards" of the Intelex look a bit complicated, but the robot rarely if ever errs. It combines some of the principles of the dial telephone, magnetic recording, printing telegraph equipment and automatic bookkeeping.

well. The records are prepared by an announcer, and as the status of available space changes, the information is automatically supplied the announcer by the diagram attendant. Such a system provides the utmost in flexibility when cars or sections are added to trains, and if abnormal conditions prevail that fact can be recorded and thus at once made known to all the personnel. The car diagrams themselves are not referred to when inquiries for space are made. Instead of listening to the voice of the distributor, the ticket seller or telephone-reservation clerk gets his information from a record that has been prepared in advance and that he selects without disturbing the diagram attendant.

After the agent has determined what space is available and the customer has reached a decision, the former presses appropriate buttons on a newly developed device known as a "key box" that automatically sends a code message to the central electronic switching equipment. There, from 60 automatic file drawers in each of a series of cabinets, the message electronically chooses the drawer containing the car diagram for the date specified and slides it out in front of the person in charge of the file. During this operation the same code message appears in printed form on the teleprinter alongside the attendant. This tells her what train is desired, the date of departure, the number and type of space, the boarding point, destination and serial number. After she enters this information on the diagram, she types the space assignment on her teleprinter, and that message is automatically transmitted to the ticket agent. Consequently, there is a record of the entire negotiation on the printer at the space file and at the selling point. The whole "machine" operation can be accomplished in fifteen seconds, although the transaction time may run to three minutes, depending on the passenger and his knowledge of what he wants.

A prospective traveler may also reserve space from his home or office by telephoning the reservation bureau. The clerk follows the procedure as just described, but in addition to assigning space he secures the customer's name and makes arrangements for the ticket to be picked up before the expiration of a specified date and at a ticket office most convenient for the purchaser. Meanwhile, all information regarding the transaction is sent by teleprinter to the designated office, where the message is filed pending his arrival. A new type of file retains the tape message and indicates whether or not the reservation has been called for within the time limit. Should the time expire, or the customer cancel the reservation, word is sent back to the reservation bureau and the space is reëntered for sale. Thus, by utilizing electronic speed and mechanical accuracy, ISTC engineers, in collaboration with railroad personnel, have solved the problem of making railroad reservations.

Since the first revenue-producing passenger boarded a train in 1830, millions of dollars have been spent to assure his comfort, safety, and speed from starting point to destination, but little thought was given to one of the greatest annoyances of travel—the interminable wait at the ticket-office window. Now, with the Intelex Automatic Reservation System, the customer's first contact with the railroad is as streamlined as the train.

Removing Guesswork in Scrap-metal Segregation

THE recovery of metals and alloys from scrap is a large and important function of steel mills and various metal-fabricating plants. Rapid spot-testing techniques now assist them in solving scrap-segregation problems. When scrap doesn't pour into steel mills in a steady stream, full-capacity operations are impaired. Geared to produce at the rate of more than 8½ million gross tons monthly in 1951, the steel mills were buying about three million gross tons of scrap per month and producing about that much more themselves. When a normal 45- to 60-day supply in the country's major mills dropped to from a one- to six-day supply near the end of November, the steel companies voiced alarm over the prospect of hungry furnaces unless the flow of scrap was accelerated.

In these mountains of critical scrap are thousands of tons of strategic metals and alloys. Careful segregation, which is essential to optimum salvage, would be a near-impossible and highly inefficient task without reasonably conclusive and speedily applied testing methods. To aid in this work, International Nickel Company, Inc., through its Development and Research Division, has published a pamphlet, *First Aid in Scrap Salvage*, outlining some simple and easily carried out tests for the identification of nine wrought white metals and alloys in general use in many fabricating shops.

With only concentrated nitric and hydrochloric acids, potassium ferricyanide, distilled water, a magnet and a small medicine dropper and a few simple procedures, one can determine nickel, Monel, Inconel, Incoloy, 70/30 cupro-nickel and four kinds of stainless steel. If scrap segregation goes beyond these nine materials, there is available a revised edition of *Rapid Identification of Some Metals and Alloys* published by the same division. It describes procedures for quickly making qualitative determinations of more than 125 metals and alloys —both wrought and cast. With these aids, scrap can be labeled and routed with a minimum of time and effort.

This and That

New Sulphur Strike

The shortage of sulphur that has been worrying industries in many countries seems to be on the way of being terminated. Freeport Sulphur Company announced late in 1951 that a new deposit, believed to be capable of yielding 500,000 tons a year, has been discovered in the marshland of the lower Mississippi River delta 100 miles southeast of New Orleans. Of characteristic dome shape, it was located by the Texas Company in exploring for petroleum on the flanks of the formation. Freeport will erect production facilities on the 1000-acre site immediately and expects to have them operating sometime in 1953. Another source of relief is reported from Canada where prospectors and chemists have determined that a huge deposit of bituminous sands in the Province of Alberta averages 5 percent sulphur.

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Moving Day for Church

This is a sort of sequel to an article on Nevada mining camps in our December issue. Last month St. Patrick's Catholic Church in Tonopah celebrated its fiftieth anniversary, and in connection with the ceremonies it was recalled that in an earlier day religion occasionally had to give way to mining interests.

At the turn of the century Father Butler had a thriving church at Austin in the Toiyabe Mountains north of Tonopah, but as most of his parishioners took off for the scene of the new gold strike he had little choice but to follow suit. He arrived in Tonopah in December, 1901, and within a month had raised funds to build a church. It was erected on St. Patrick Street, on hillside property owned by the Butler Mining Company.

By 1914 the church and rectory were hemmed in by mine dumps, and the company wanted the ground they occupied, so a move had to be made. A tract farther up the hill was obtained, a dump that covered it was leveled, and the buildings were transported there, mostly by human muscles. Nobody knew much about moving a church, but Father James Diss, the pastor, managed to get it done in short order.

One afternoon as the 3:30 shift was coming up from underground at the nearby Mizpah Mine, a keg of beer was awaiting them at the church, and they were informed that there was another keg at the new site. Somewhere around a hundred of them volunteered for service. Details are lacking as to how they did it, but by nightfall the structures reposed on the higher ground. Old-timers say that a mine shaft is directly under either the church or the rectory.

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Uranium Found in Phosphate

Minute quantities of uranium, basic atomic-energy mineral, are scattered over the farm lands of America. It was deposited there with fertilizers derived from phosphate rock mined in Florida. Sheldon P. Wimpfen, of the Division of Raw Materials, Atomic Energy Commission, recently told of steps being taken to extract the uranium before the fertilizer is distributed. The Florida Bone Valley formation, of marine origin, contains from 2/10 to 4/10 pound of uranium per ton of rock. Although the concentration is low, the amount of rock processed each year is so great that the aggregate content of uranium is well worth saving.

Research aimed at discovering methods for reclaiming the uranium were carried out by Massachusetts Institute of Technology, Battelle Memorial Institute, and Dow Chemical Company. One full-scale recovery plant is being operated by the Blackson Chemical Company, Joliet, Ill., and pilot plants are functioning at some other locations. Tennessee also produces phosphate rock, but it contains no uranium. Tests indicate that uranium has no effect on vegetation, so it will not be missed from the fertilizer.

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Huge Alcan Project

Probably the largest single construction job ever undertaken in Canada is underway in British Columbia, some 400 miles north of Vancouver. There the Aluminum Company of Canada has initiated a 3-point program that will, upon completion, include a 1,800,000-kw hydroelectric development, an aluminum smelter of 500,000 tons annual capacity, and an industrial city to house 50,000 persons. The eventual cost is placed at around half a billion dollars, with first-stage contracts aggregating 168 millions.

Various features of the Alcan Project, as it is known, will be spread over an area running 160 miles east and west by 60 miles north and south. To collect and maintain a supply of water for power generation, a dozen large lakes and many more smaller ones on the headwaters of the Fraser River will be combined into a huge reservoir—Lake Tahtsa—with its waters backing up to the eastern flank of the Coast Range. The key structure in its formation will be Canyon Dam, at the eastern end. It will rise nearly 300 feet, have a crest length of 1500 feet and contain five million cubic yards of fill. At the western end of the lake a tunnel, 10 miles long and 25 feet in diameter, will be carried through the range. From the western portal of the bore, water will drop through penstocks to an underground powerhouse on the Kemano River that will ultimately contain sixteen generating units, each consisting of a 150,000-hp turbine driving a 106,000-kva generator.

Power will be transmitted 49 miles northwestward to a mile-long aluminum smelter to be erected at Kitimat, site of an old Indian village. The line will cross rugged terrain at elevations 5000 feet

"That's Worry Wart for you. Doesn't trust his own dam building."

and upward, and the winter climate will tax the largest (2¼-inch) conductors ever assembled. A small section was put up for test and observation last winter.

Alumina refined from bauxite ore in the British West Indies will be transported 6000 miles to the smelter's pot lines and converted into aluminum metal. The plant's capacity will equal that of all those in the current expansion program of the United States' aluminum industry. It will approximately double the present output in Canada.

Several years of planning preceded the launching of construction. First production of aluminum is scheduled for 1954, and a gradual increase in power generation and aluminum output is expected in succeeding years. Morrison-Knudsen Company of Canada, Limited, an affiliate of Morrison-Knudsen Company, Inc., of Boise, Idaho, has the contract for the hydroelectric features and is being assisted by two Canadian firms: Mannix Ltd. of Calgary, and Northern Construction & J. W. Stewart Ltd. of Vancouver. The design work is in charge of British Columbia International Engineering Company, with W. G. Huber directing it. The Aluminum Company is designing the smelter. The town is being laid out by Clarence F. Stein, representing the Aluminum Company, in coöperation with Mayer & Whittlesey, of New York City.

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Tapping Cerro Bolivar

To facilitate opening up its newly discovered Cerro Bolivar iron deposits in Venezuela, United States Steel Corporation has awarded a contract for the dredging of a channel in the Macareo and Orinoco rivers that will permit large ore-carrying ships to go inland 170 miles from the Atlantic Ocean. At the terminal, Puerto Ordaz, they will be loaded with ore that has been hauled 90 miles from the mines by railroad. Dredging will be done with floating hydraulic cutterhead units and will be handled jointly by McWilliams Dredging Company, of New Orleans, La., and Gahagen Construction Corporation, of New York. The contract amounts to more than $15,000,000 and will take around 24 months to complete.

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Industrial Diamonds News Again

As the defense program gathers speed, industrial diamonds are again becoming important, just as they were in World War II. Moreover, as the demand for them grows, so does their cost. The Office of Price Stabilization price is $2.75 a carat, but we are informed that the prevailing figure is $4.10 and that up to $8 is being paid in the black market. At their present tempo, American industries need around ten million carats a year, but imports are running some 30 percent under that amount. Dealers also say that from 10 to 35 percent of the stones that come in are taken by the Government for stockpiling, and some are reportedly being smuggled out of the country and sold to Russian agents in Europe for as high as $12 a carat for whole diamonds and diamond dust.

The increase in the demand for these second-grade stones has been little short of phenomenal. A few years ago diamonds that were unsuitable for use as gems were a drug on the market, whereas now they are more readily salable than the gem variety. Industrial-grade stones represent about 80 percent of all diamond production, and the ratio is increasing as mines that have been closed for years are being reopened in response to ascending prices.

The rise of the industrial diamond led South African mines to organize the Diamond Research Laboratory in Johannesburg four years ago. Its purpose is to assist both producers and users. According to a laboratory spokesman, a large proportion of the annual diamond output is now used in making grinding wheels and wheel-dressing and forming tools for the final lapping and finishing of metal-cutting tools, especially those with tungsten-carbide tips.

"For the finish turning and boring of non-ferrous metals and certain non-metallic metals for which a very high precision surface finish is required," it is stated, "the shaped and polished diamond tool has no rival. The mirror finish required in the manufacture of tungsten-carbide extruding and wire-drawing dies cannot be satisfactorily obtained unless diamond powder is employed as the abrasive element. In the wire-drawing industry, diamond dies have been in use for many years for the economical and accurate drawing of ferrous and non-ferrous wire of sizes ranging from 0.05 inch with copper wire down to the smallest required gauges."

Then, too, diamond drilling is the foundation of all deep-level mining. From cores brought to the surface geologists determine the depth of mineral deposits, their thickness and character, and the general underground structure. A recent interesting and new application is a rock-sampling machine. Twin diamond cutoff wheels driven by an air motor will take from any rock face a sample ⅞ inch deep and of almost any desired length. The device is expected to do away with the unsatisfactory method of chip sampling.

The effort to improve existing diamond-mining practices leads to the consideration of many problems. It is stated, for example, that in the world-famed Premier Mine at Cullinan, Transvaal, about fifteen million pounds of earth must be moved to recover a pound of diamonds, and this may be fairly representative of the industry as a whole. At Premier this involves handling 700 tons an hour. At the surface dump, tailings are literally hurled over the edge of the huge mound by a centrifugal "thrower" fed by a conveyor belt.

An electrostatic method of separating diamonds from the gravel matrix promises greatly to reduce the loss of small stones. The conventional practice is to pass the concentrates in a flow of water over a grease table. As diamonds are not ordinarily wettable, they cling to the grease. However, because impurities form on the surfaces of stones found in South West Africa, they do not repel water and consequently many of them are not caught by the grease. But the electrostatic method will catch even the tiny ones.

In coöperation with the Chemical, Metallurgical and Mining Society of South Africa, the Diamond Research Laboratory will hold a symposium on diamond drilling in Johannesburg April 21-23. Following the technical sessions, visitors will be shown some South African gold and diamond mines and the copper deposits of Northern Rhodesia.

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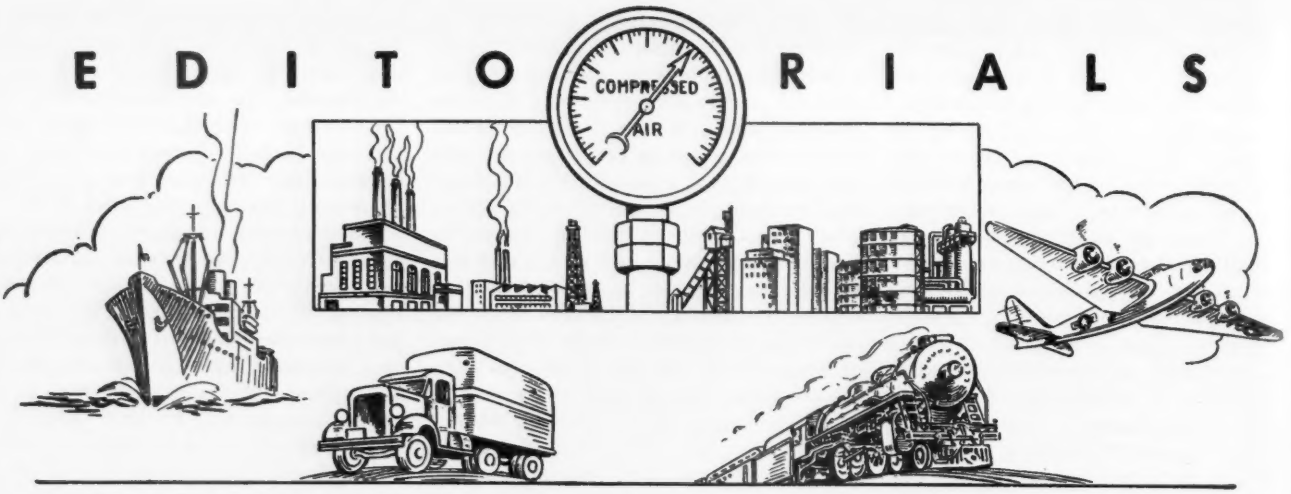
Air Starter for Jet Airplanes

A new air-operated starter for the turbine power plants of the Air Force's big jet bombers has been developed by Hamilton Standard Division of United Aircraft Corporation. It is lighter than the electrical equipment in previous use and many times more powerful. Tests indicate that it will start in not more than twenty seconds the highest powered turbine now being built or under consideration.

The starter consists of a bladed wheel that is connected through a gear train and clutch to a plane engine turbine. Air impinging on the blades turns the wheel at up to 45,000 rpm, at which speed it delivers 100 hp. For starting the first engine on a plane, air must be obtained from an outside source. Once a single engine is turning, it provides a source of compressed air to be fed through the starter of the next engine.

In announcing the starter, Erle Martin, general manager of Hamilton Standard Division, commented that it is in line with a general trend toward pneumatic operation of accessory systems of turbine-powered aircraft. "The availability of air in vast quantities from the turbine-type power plant, simplicity and lightness of installation and ease of maintenance contribute to the superiority of pneumatics as a source of power," he said. Last summer the company introduced an air-cycle refrigeration unit for jet-fighter cockpits.

EDITORIALS



KEEP YOUR DRILL HANDY

THE ATOMIC AGE is making work for the rock driller. Never since Neolithic man moved out of caves into villages has there been so much thought about underground havens from possible disaster.

Old mine workings, heretofore considered menaces, have suddenly become assets, especially if they are located near sizable concentrations of people. Not only is consideration being given to the idea of using them as bomb shelters, but in various parts of the country enterprising promoters are fitting out underground galleries as storage places for valuable corporation and personal papers. The day may come when we will descend a shaft or enter a tunnel to gain access to our safety-deposit boxes that now repose in bank vaults.

Some large cities fortunately have subway railroad systems that can shelter thousands of people in the event of a bomb attack. They also have tall buildings with several basement levels. A few, such as New York, are founded largely on rock and consequently offer unusually safe subterranean gathering places.

Existing excavations would, however, accommodate only an insignificant fraction of the urban dwellers who would rush to them if bombs began to fall. For that reason many communities are providing or planning additional ones. The trend is more or less international, judging by reports, and it is a safe guess that a large proportion of such undertakings are not given publicity.

Even nations that have escaped the last two world conflicts are shelter-conscious. For example, Stockholm, Sweden, has already built several subsurface bombproof refuges and has announced that another one will be constructed underneath the central business section. It will be in the form of a tunnel with several entrances and will be used in normal times to garage 500 automobiles.

England also is giving serious thought to similar underground burrows that can help both solve the parking problem and offer human moles asylum should bombs start dropping. Moreover, it is being urged that ample facilities for such a dual purpose be provided under all business buildings to be constructed. The same idea has been acted upon in various American cities. In Los Angeles, for instance, there is a huge garage under a public park that can be quickly converted into a retreat for harried humans if the need arises.

Although precautions are being taken in cities, there would undoubtedly be a wholesale exodus to rural areas if large-scale air attacks materialized. With that possibility in mind, according to reliable reports, some large corporations with principal offices in New York City have microfilmed their important records and placed them in underground depositories miles from Broadway. As is well known, Germany had whole factories underground in the recent war, and similar measures would probably be taken by most belligerents in the event of another world-wide conflict.

In the face of all these dire possibilities it is prudent that we keep not only our powder dry but our rock-drill bits well sharpened.

Scrappy Meets His British Chum

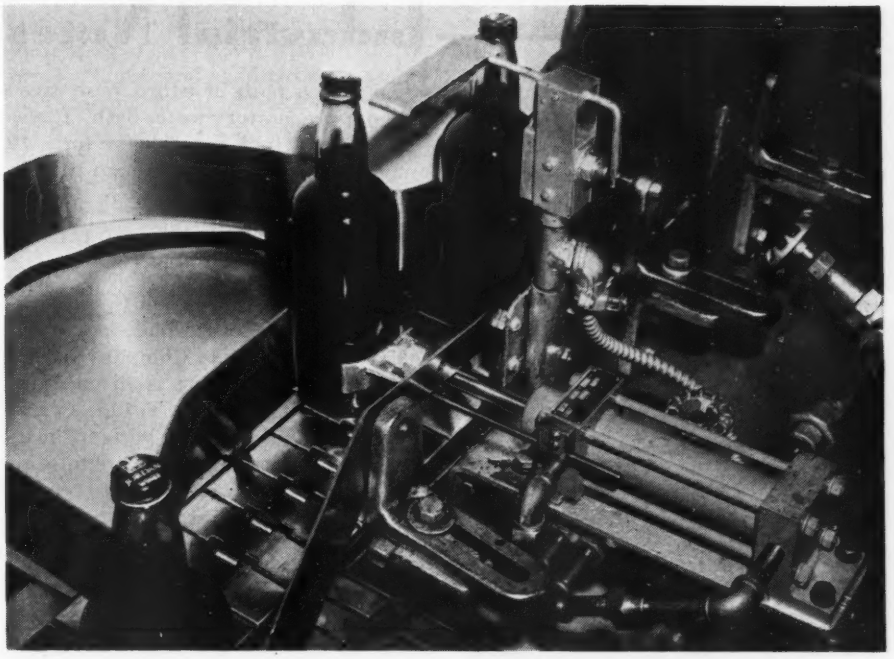
SCRAPPY JACK SCRAP

Iron and steel scrap is important in the defense programs of both the United States and Great Britain, and the two nations are publicizing the need of it in much the same way. Our symbol of scrap is "Scrappy," created by the Advertising Council, and his slogan is "More Scrap Today . . . Makes More Steel Tomorrow." His British counterpart is Jack Scrap, whose battle cry is: "Speed the Scrap—Speed the Steel."

ATTENTION INVENTORS

AN APPEAL has been issued by The National Inventors Council for a "light, durable, corrosion-resistant, hand-operated aerosol sprayer for spraying military quarters with insecticides." The apparatus should be durable enough to withstand long and hard usage and yet preferably weigh less than 12 ounces. The reservoir for liquid should be contained within the plunger of the hand air pump and have a capacity of at least 3 ounces. The sprayer must be able to operate in any position and not drip liquid at the end of the spraying stroke. Complete specifications can be obtained from the National Inventors Council, Office of Technical Services, U. S. Department of Commerce, Washington 25, D.C.

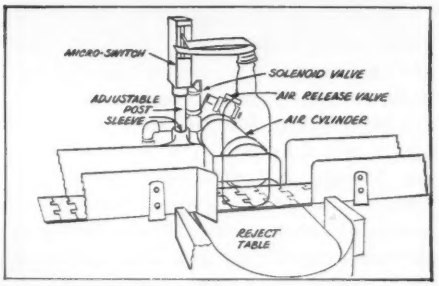
Air Device Rejects Improperly Sealed Bottles



NO IMPROPERLY capped bottle leaves the Bottling Division of Danforth Wines Limited and Jordan Wine Company Limited since the introduction there of an air-operated device that automatically pushes them off the production line. The ejector was designed and built by Harry C. Englefield, chief engineer of the Canadian firms. As now installed, it is an improvement upon an earlier or pilot model. It stands guard near the delivery end of a traveling conveyor and remains inactive until a bottle comes along that has a loose cap, a cross-threaded cap or a cap with two liners, which prevent tight closure even though each has an approximate thickness of but 30/1000 inch.

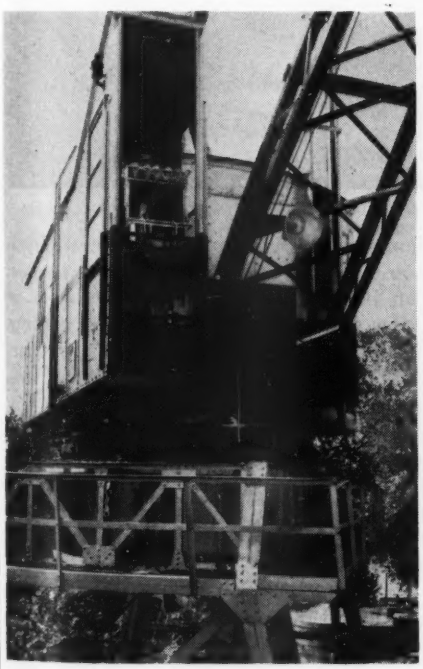
The principal features of the device are a double-acting pneumatic cylinder mounted horizontally at right angles to the production line, a solenoid valve, and a microswitch to which a bar is attached. The microswitch is set for a tolerance of 25/1000 inch, but tolerances as fine as 4/1000 inch are permissible. When a bottle, because of an imperfect seal, comes in contact with the bar, the latter trips the microswitch which, in turn, actuates the solenoid valve through which air, at a pressure of 70 psi, is admitted into the 1½-inch-diameter cylinder.

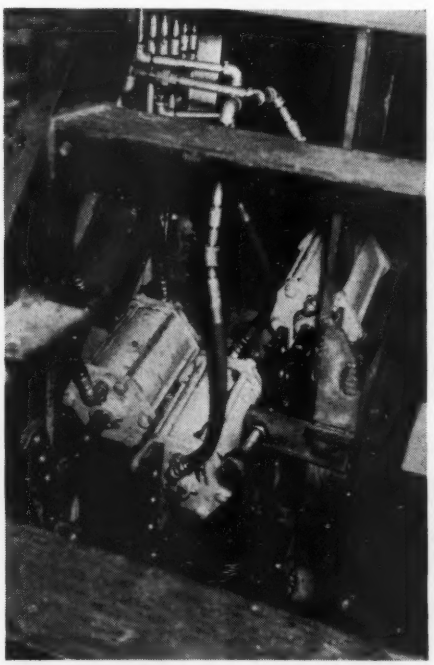
With the conveyor moving along at a predetermined speed, the cylinder piston rod pushes the bottle on to a reject table and returns to its starting position. The cycle of operations is performed so quickly that the progress of the next bottle on the line is not impeded. It is reported by S. C. Torno, vice-president of Danforth Wines Limited, that complaints from customers regarding improperly applied caps have ceased since the pneumatic ejector was installed.



INSTALLATION AND LAYOUT

The second bottle on the conveyor is improperly capped and has come in contact with the bar which controls the microswitch that sets the ejector operating cycle in motion. The bottle is being pushed on to the reject table by the air cylinder at the right. It is of the double-acting type for a quick return stroke to clear the path for the following bottle. The outer end of the piston rod is provided with an arm that fits the contours of the bottle and holds it during its removal from the production line.



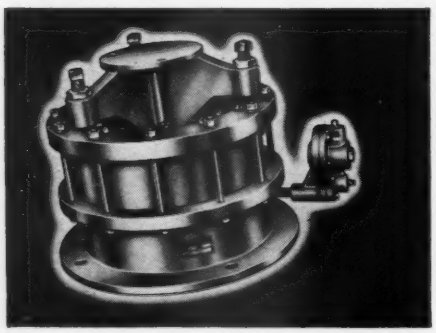


NEW CONTROLS FOR OLD CRANE

Pneumatic controls are now built into many types of heavy construction machinery, but their application to units that have been in service for a long time is comparatively rare. It was done, however, in the case of a 20-year-old revolving crane that handles bulk materials such as sand and gravel for the Southern Materials Company, Richmond, Va. Air power has replaced human muscles for operating clutches and brakes. The crane runner formerly had to stand to exert his full weight on the foot pedals and hand levers. He was a big man of exceptional strength, but when he became ill no one was found who could do the job satisfactorily. Five air cylinders and a 5-hp air compressor were the principal components required to effect the conversion. The maximum force now required to operate any of the pedals or levers is 10 pounds. The pictures show the crane, an electrically driven unit with a 70-foot boom, and four of the Westinghouse Air Brake Company's pneumatic cylinders utilized.

Industrial Notes

Designed for batch weighing or continuous process control, the F-C Air Scale or weight transmitter recently announced by Fluid Controls Company, Inc., converts a variable force or weight into an easily measured pneumatic signal. It is operated on the force-balance principle and indicates, records, or controls weight or force through standard

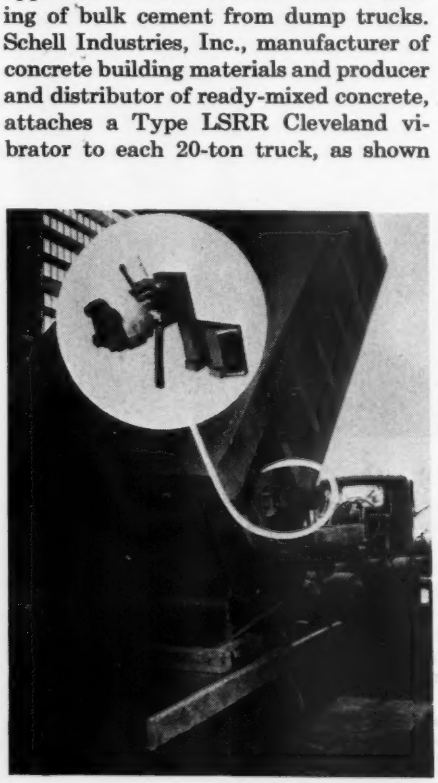


panel-board instruments. Basically, the device consists of a platform and of two separate air chambers with diaphragms —a tare-weight chamber and, below it, a net-weight chamber, all in a metal housing. Weight or force applied to the platform on top of the scale closes a bleed nozzle at the bottom. The pressure in the net-weight chamber then increases until, multiplied by the effective area of the diaphragm, it equals the load on the platform. If the latter is decreased, the bleeder nozzle is lifted from its seat, exhausting air from the net-weight chamber until the pressure once more equals the weight on the platform. The tare-weight chamber is automatically air loaded to counterbalance the fixed load on the platform so that the reading shows the net weight only. Applications of the unit range from simple weighing operations to elaborate batch or continuous-flow control of solids or liquids and to torque and thrust measurements of jet engines. Being completely enclosed and using compressed air even for remote recording, it is not an explosion hazard and well adapted for use in food-processing, milling, chemical and glass plants. Sizes handling a maximum of 40 tons are available; others for heavier loads are made to order. One capable of weighing up to 5 tons occupies less than a cubic foot of space.

For the protection of linemen and of maintenance workers exposed to electrical hazards, South Eastern Cordage is offering a manila rope that is said to have considerable dielectric and shock-resistant properties. Trade-named Se-Lectric, it is made water repellent by treating it with chemicals. As proof of its effectiveness, the company cites a test with two pieces of ½-inch rope of equal length both of which were given a 2-hour preparatory water bath. It was found that it took but 5 kv to force 10 milliamperes of current through the untreated piece, as against 73 kv in the case of the nonconductive rope.

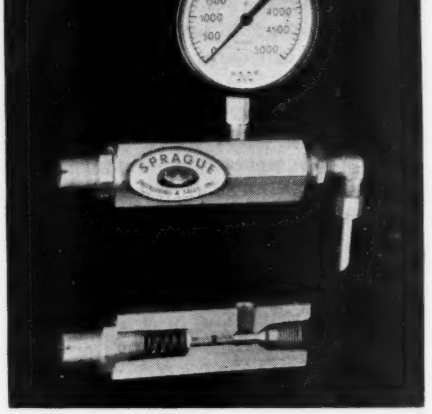
Announcement of three new lubricants for wire rope, rail joints and anti-friction bearings was made simultaneously by The Texas Company at the close of 1951. The first is an improvement upon the previous Texaco Crater A. A thin liquid applied without heating, it will penetrate and adhere to dripping-wet wire rope and is said to remain plastic under a wide range of atmospheric conditions. The Rail Joint Lubricant is a rust preventive that "remains pliable even at subzero temperatures, will not evaporate in hot weather, and is relatively unaffected by prolonged water washing." It is of a consistency suitable for spraying. The third product is called High Temp Grease. According to the company, it offers ball, roller and plain bearings unusual protection at temperatures up to 300°F for continuous operation and 350° for intermittent operation, exceeding established military and industrial standards in this respect. Other characteristics claimed for it are excellent oxidation and water resistance and efficient performance at high speeds.

Air vibrators have a wide field of use and are eliminating much hard shovel work in handling materials that have a tendency to pack. One of the newer applications has to do with the unloading of bulk cement from dump trucks. Schell Industries, Inc., manufacturer of concrete building materials and producer and distributor of ready-mixed concrete, attaches a Type LSRR Cleveland vibrator to each 20-ton truck, as shown



in the accompanying illustration. Operating intermittently just to keep the cement moving it discharges the load in 30 minutes, a time interval that could be considerably reduced if the unit were allowed to function continuously. Provided with a male and a female bracket, the vibrator can be shifted quickly from one truck to another.

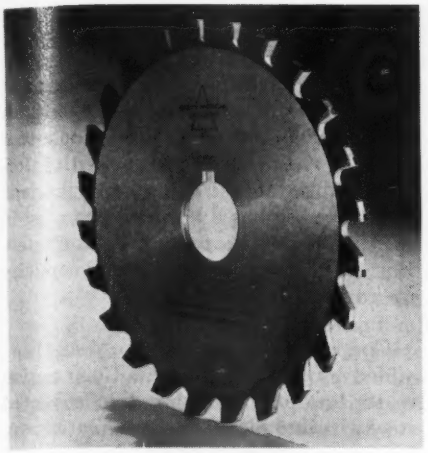
Production of a new shutoff valve designed especially to protect gauges in pneumatic and hydraulic systems has been announced by Sprague Engineering & Sales Corporation. The device automatically cuts out gauges when the pressure goes beyond their operating limits and opens them when the pressure is again within their range. A compres-



sion spring controls the pressure shutoff point. Both minor and major changes can be made, the first by adjusting a screw and the other simply by replacing the compression spring with another (the heavier the spring the higher the pressure shutoff point). All units are supplied with standard pipe-thread connections but can be furnished with AN adaptors for aircraft fittings. They are available for low-pressure systems (30 to 300 psi) and high-pressure service (500 to 5000 psi).

Under the name Kurl-Off, the Hillyard Chemical Company is marketing a nonflammable paint and varnish remover—a clear, colorless liquid that is said to lift stubborn coatings from metal and wood surfaces in a matter of seconds. It is available to anyone who can furnish a Defense Order.

North American Products Company has introduced a carbide-tipped saw for complete roughing and finishing, slitting and grooving operations on ferrous and nonferrous metals. Outstanding production records have been made by



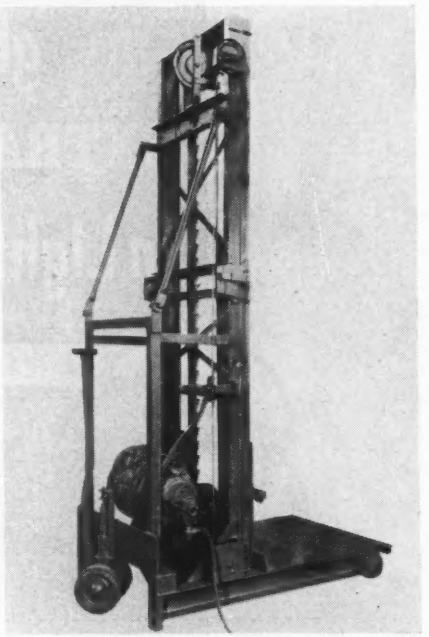
these new blades on alloyed cast iron, copper, aluminum and annealed alloyed-steel bars. Cuts 6¾ inches deep have been taken in cast iron and 2¼ inches in steel, and the saws have held tolerance to 0.002 on slots 4½ feet long. It is further claimed that they increase cutting speeds four to five times, as compared with steel blades, and succeeded in cutting through Inconel X when no other blade could be found to do the job. They are available in 3- to 18-inch diameters and in widths from 0.085 to ½ inch.

Unlike present road-repairing materials, Komac premix, a product recently announced by Koppers Company, can be stockpiled ready for use in any kind of weather and laid down without heating. Using standard equipment, the compound is merely tamped or rolled in place and can, it is said, carry traffic as soon as it is compacted. Komac will soon be put on the market as a road-paving material.

For the removal of liquids and solids from compressed-air lines, C. A. Norgren Company has developed a combination filter and drain that operates automatically under constant or fluctuating air pressure and flow and continues to function when the air supply is cut off. Drainage of condensate in lines when equipment is shut down is therefore assured. Sludge and solid particles are removed from the air before it goes to the drain chamber so as to prevent clogging or the float from sticking. The pressure drop through the filter is said to be extremely low. The Filter-Drain is recommended for a flow of 0-35 cfm at from 0 to 150 psi pressure within a temperature range of 40 to 120°F. It is available in three pipe-thread sizes—¼, ⅜ and ½ inch.

Moving precision parts such as stems and guides, thrust washers, pump pistons and gears, as well as bearings are given a twofold protection by a chemical treatment announced by Octagon Process, Inc. Known as Rustshield 2, it is a phosphatizing compound that is applied by hot immersion in a stainless-steel tank and is said to produce rustproof, oil-retaining surfaces that remain properly lubricated far longer than does smooth steel. Close tolerances are not affected by the treatment.

In place of electric power, Barrett-Cravens Company uses compressed air to operate its new portable elevator designed especially for service in hazardous locations such as dust and explosive-vapor areas. It is equipped with an Ingersoll-Rand air-motor hoist that consumes approximately 2.5 cfm at 80 psi per foot of lift. In addition to safety-first construction, the elevator has the following features, according to the company:



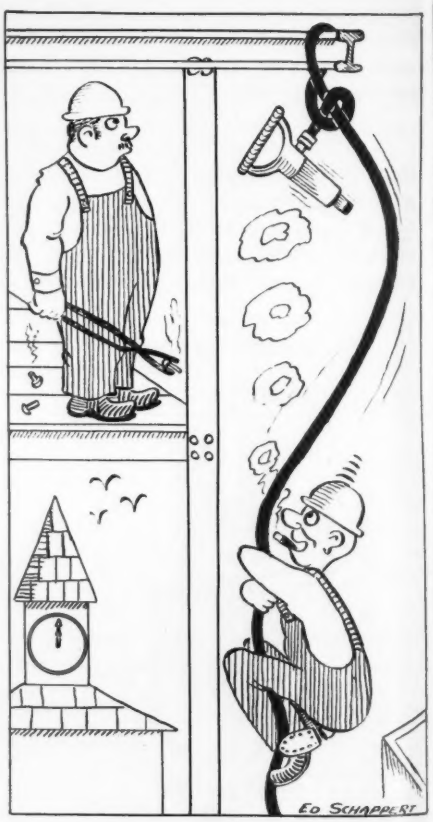
an automatic brake which positively holds the load; an up- and a downstop which cut off the air and halt the motor just before the platform reaches the top

and the lower levels; a graduated reversing valve which gives complete control of the platform in any position; and a poppet throttle valve that prevents air leakage when the hoist is idle. The motor is of the radial airplane type with interchangeable and renewable cylinders, and the hoist has a large oil chamber in which all moving parts are lubricated. Barrett elevators have a lifting capacity up to 2000 pounds.

Copper-plated steel wire has been added by Kenmore Metals Corporation to its line of Fernicklon (nickel-plated steel wire and nickel or silver-plated copper wire). Trade name Copperon, it is made by a continuous electroplating process in sizes ranging from ⅜ inch in diameter to the finest gauges. It is claimed that pounding by hot rolling or cold drawing and temperature changes will not destroy the bond.

Users of coal can, perhaps, save themselves a lot of annoyance from dust by spraying on Sealtite during delivery with a pressurized container called Dustroyer. Both are made by Midland Sealtite Corporation, which claims that the liquid not only lays the dust but coats the coal to prevent the spread of more dust. The applicator comes with interchangeable nozzles and can be refilled. Recharging is done by a tire pump, compressor air or a carbon-dioxide cartridge.

Baseball bats are now bleached and dyed by a process that has widespread



"Chow Time!"

use in creosoting timber and impregnating wood with resins and other compounds. The bats are placed in an airtight chamber which, together with the wood, is evacuated by a high-suction pump to a point where sufficient moisture is retained to prevent the bats from becoming overdry and splitting. The latter are then immersed in the bleaching liquor, which is introduced from an adjacent tank, removed from the chamber after a predetermined period and dried. The same procedure is repeated with the dye, using the same equipment. Vacuum impregnation assures deep and quick penetration of the bleach and dye and also permits close control of the color.

MINE OPENING IS AIR RECEIVER

The unused end of a drift in the Senator-Rouyn Mine at Rouyn, Canada, has been sealed by a 7-foot-thick concrete bulkhead to form an underground air receiver measuring approximately 7x8 x175 feet and having a capacity of a little less than 10,000 cubic feet. With this large volume of air in the distribution system, line surges are eliminated and an adequate supply is insured when a sudden demand has to be met. The mine compressors have a combined capacity of 2500 cfm. The picture shows the exterior wall of the bulkhead. Overhead are 6-inch lines, one for ingoing and the other for outcoming air. They are so arranged that they can be readily joined with a crossover to by-pass the receiver when that is desired.

It takes an average of 44 tons of steel piping for each oil well drilled in the United States. This includes only the casing and tubing, not the drill pipe.

At the Norfolk Naval Shipyard in Portsmouth, Va., each painter has his own air-conditioning system which is made up of a harness of perforated rub-

ber hose worn under the clothing. One end of the line is attached to a source of low-pressure air, which escapes through the openings and keeps his body cool.

For filling hairline cracks and small holes in plaster, wallboard and wood the Magic Iron Cement Company, Cleveland, Ohio, is offering what it calls Magic Plaster Mix. In stick form, the filler can be gone over with paint as soon as it is applied and will not, it is claimed, bleed through the coating.

To prevent loss of air pressure or water leakage in aircraft at high altitudes, The B. F. Goodrich Company has developed a hollow strip seal made of a special textile coated with rubber on both sides and vulcanized in collapsed condition to a flexible-rubber base. Inflation or sealing is effected instantaneously by admitting low-pressure air.

Equipment and workers can be protected against radiant heat as high as 2000°F., it is claimed, by Ray-Foil, a flexible protective fabric made by Safety First Supply Company. It reflects heat as a mirror reflects light and can be used as a curtain, a shield to be set up or carried, a glare baffle, and even as a clothing, insole, and glove material.

Every day, at Butte, Mont., 30,000 tons of water pumped from the mines of Anaconda Copper Mining Company is passed through six launders or basins that contain shredded, detinned cans. There copper sulphate, carried in solution, is precipitated by the iron in the form of "cement copper" which has a 75-percent copper content. Every month 750,000 pounds of copper is recovered that would otherwise flow into the headwaters of the Missouri River. The precipitation plant was described in detail in our October, 1949, issue.

" . . . and get those onion sandwiches away from the air intake."

Industrial Literature

A 32-page booklet, titled *Correct Fire Protection*, gives detailed information on how to handle a fire extinguisher and tells which one of the different types available should be selected for a certain class of fire. A letter to the American-LaFrance-Foamite Corporation, Elmira, N.Y., will get you a copy of this valuable guide.

The Michigan Wire Cloth Company, 2100 Howard Street, Detroit 16, Mich., has published a 6-page brochure that deals with wire-cloth strainers. It discusses the design of, selection of grade of wire cloth for, and the construction features of strainers. Those desiring copies should write for *Engineer's Manual of Wire Cloth Strainer Design.*

A 32-page manual on pressure- and vacuum-actuated switches is offered to qualified pressure-switch users by Barksdale Valves, 1566 East Slauson Avenue, Los Angeles 11, Calif. Designated as Catalog 1MB-1, it includes a glossary of terms, circuit diagrams, operating characteristics and other valuable information.

Paint anchoring and phosphatizing may be new and meaningless terms to most of us but to those responsible for applying lasting paint surfaces to metal objects they have real significance. Anchorite 100 is a phosphatizing compound described in a booklet published by Octagon Process, Inc., 15 Bank Street, Staten Island 1, N. Y. Copies are available upon request.

Complete engineering data on synclinal-type filters for sump or line installation on hydraulic and low-pressure liquid recirculating systems is contained in a folder recently published by the Marvel Engineering Company, 625 West Jackson Boulevard, Chicago 6, Ill. Single units are available in capacities from 5 to 100 gpm with a choice of mesh ranging from 30 to 200. If interested ask for Folder No. 105.

The 31st edition of *Automobile Facts and Figures* is now being distributed. This publication, available upon request from the Automobile Manufacturers Association, New Center Building, Detroit, Mich., is the result of a full year's work by a staff of research men and statisticians. In its 80 pages it contains pertinent information regarding the industry, automobile distribution and use, taxation, registration and other salient economic aspects.

Special lubricants for the severe drawing, forming, stamping, cutting and piercing of stainless steel and other hard metals are described in Bulletin No. 10-2 made available by the Forbex Corporation, 125 Broad Street, New York, N. Y. The company calls these lubricants its "Ten" Series and states that they permit reductions heretofore unobtainable with conventional lubricants. Other advantages claimed for them are greater production; longer life for dies and cutting tools; gall-free and scratch-free surfaces; reduced scrap; and no preparatory surface treatment.

The Hagan Flow Signal Transmitter is designed to establish a pneumatic loading pressure or signal having a predetermined relation to a pressure differential imposed on the measuring elements. It transmits proportional signals to remote recording or indicating instruments or to automatic control elements. Applications include measurement of steam output from a boiler, superheater or evaporator; of feedwater flow to a

boiler; of liquid flow through pump units; and of gas, vapor or liquid flow in process systems. Copies of a new bulletin (No. 2551) describing the transmitter can be obtained from the Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

A new 40-page catalogue covering pH (hydrogen-ion concentration), oxidation-reduction potential, and electrolytic conductivity contains data on equipment for these vital process variables. An extensive revision of an earlier publication, it gives new information on the latest designs of pH electrodes and conductivity cells. Included are fundamental operating principles, descriptions of measuring systems and details of components, as well as typical applications. Interested persons can obtain copies of Catalogue No. 15-16 by writing Minneapolis-Honeywell Regulator Company, Station 40, Wayne and Windrim Avenues, Philadelphia 44, Pa.

One of the grim facts brought out in a new 8-page bulletin issued by Remington Rand Inc., 315 Fourth Avenue, New York 10, N. Y., is that 43 percent of the establishments whose records are lost by fire go out of business. Entitled *The Cost of Burned Records*, it deals with the measures that should be taken to insure 100 percent protection against such losses. Write to the company's Management Controls Division for Folder SC 707.

For those manufacturers who have not had previous defense production experience and to refresh the memories of those who have had such experience, the Alloy Rods Company, York, Pa., has issued a brochure titled *Alloy Welding Electrodes for Defense Production*. Greater quality requirements, improved electrodes and welding techniques make the bulletin, AR51-1, timely and of interest. It is available upon request to E. R. Walsh III, general sales manager of the Company.

Fischer & Porter Company, veteran manufacturer of process control instruments, is offering a calibration service to industry. Since its inception the concern has operated a hydraulics laboratory and has developed unique process equipment through the years in determining the exact characteristics of innumerable fluids under widely varying conditions. These, together with the staff of its Fluids Engineering Department, are now available to industrial establishments and are fully discussed in a catalogue that may be obtained by sending a request to 5060 County Line Road, Hatboro, Pa.

In a new 12-page bulletin containing dimensional drawings, flow diagrams and performance charts among other illustrations, The Swartwout Company, 18511 Euclid Avenue, Cleveland 12, Ohio, describes its complete line of power-plant equipment, including control valves, pressure and temperature master controls, desuperheaters, water-regulating valves, liquid-level and drainage controls, differential-pressure controls, feed-water heaters and regulators, exhaust heads, air separators, etc. A copy of Bulletin S-196-C is available upon written request.

Ingersoll-Rand has just published a new booklet illustrating and describing its NL line of compressors that are designed to deliver oil-free air for agitating and processing milk and milk products. Among the advantages of air agitation discussed are: absence of mechanical parts in contact with the milk; freedom from contamination; faster and more thorough agitation with no foaming; elimination of seasonal tastes; and a substantial saving in power requirements. For complete information on the subject write to 11 Broadway, New York 4, N.Y., or any of the company's branch offices, for booklet No. 1523.

Dayton Rogers Manufacturing Company, 2824-13th Avenue So., Minneapolis 7, Minn., is offering free of charge to anyone writing on a company letterhead a celluloid pocket-size disk on one side of which are decimal equivalents from 1 inch to 1/64 inch, the diameter of tap, number of threads per inch and diameter of tap drill for U. S. Standard screw threads. By simply turning a dial to the desired tap diameter the other figures appear. On the reverse side is a similar table for A. S. M. E. special and standard machine screws, American standard taper pipe threads and S.A.E. standard screw threads.

New literature available from General Electric Company, Schenectady 5, N.Y., includes the following: Bulletin GEA-5660 describes an electronic contour follower for machining irregularly shaped parts; GEA-5682 deals with a new heat-treating machine for handling parts to be progressively induction-hardened; GEC-837 is on a new instrument for accurately measuring the thickness of thin films by means of color comparisons; GEA-4979A concerns a completely new motor control center for use wherever two or more a-c motors (up to 200 hp, 600 volts) are controlled from a central location; and GEA-5704, 5705 and 5707 pertaining to rotating-, lever- and track-type limit switches.